FINAL REPORT

Modeling TDM Effectiveness:

Developing a TDM Effectiveness Estimation Methodology (TEEM) and Case Studies for the SR 520 Corridor

Part of the
Implementing Corridor TDM Programs in the Puget Sound Region Project

Prepared for

Washington State Department of Transportation

In cooperation with U.S. Department of Transportation – Federal Transit Administration

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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Implementing Corridor TDM Programs in the Puget Sound Region

Overall Project Description

Step 1. Modeling TDM Effectiveness

Develop decision-making tools and better quantitative information about the effectiveness of TDM and land use strategies

Contained in this report:
Developing a TDM Effectiveness Estimation Methodology (TEEM)
Case Studies for the SR 520 Corridor

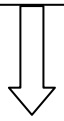
Forthcoming work, beginning 2003:
Enhancement of TEEM

Case Studies for the I-405 Corridor

Land Use and Travel Behavior Correlation Analysis

Nonwork and Nontraditional Commute Trip Research

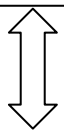
Timeframe: 2001-2004



Step 2. Develop an Implementation Plan for the Corridor(s)

Outline the actions needed to implement a TDM package for the corridor(s), recommended monitoring and evaluation processes, procedures for any necessary program adjustment, oversight structures, roles of participants, and funding sources.

Timeframe: 2003-2005



Step 3. Develop a Draft Interlocal Agreement to Implement TDM in the Corridor(s)

Cooperatively develop a draft interlocal agreement that will provide a framework for setting TDM implementation goals and a list of actions that support those goals.

Timeframe: 2003-2005

Modeling TDM Effectiveness:

Developing a TDM Effectiveness Estimation Methodology (TEEM) and Case Studies for the SR 520 Corridor

Executive Summary

Project Purpose

The purpose of this project is to produce an analytical tool that can quantify the effectiveness of TDM and land use strategies and to apply the tool in a variety of case study areas along the SR 520 corridor.

Project Background

State Route (SR) 520 is one of the main state highways in the Central Puget Sound Region of Washington state and serves as a vital link across Lake Washington, connecting Seattle on the lake's west side to Bellevue, Redmond and Kirkland on its east side. Not only is the highway, and particularly the bridge portion across Lake Washington, heavily congested in both directions during peak commute times, studies have shown that demand for travel across the bridge will continue to exceed supply. Therefore, Transportation Demand Management (TDM), land use and transit strategies play an essential part in any improvements to the corridor.

TDM and land use actions have played a significant part in both the Trans-Lake Washington Study (1998-1999) and SR 520 Environmental Impact Statement (EIS) (2001-present). The Trans-Lake Washington Study included the recommendation that interlocal agreement(s) should be developed to implement TDM and land use measures in the Trans-Lake Washington corridors. This recommendation is a key element in the TDM program developed for the SR 520 EIS. The SR 520 EIS also includes a 20-year, $285 million TDM program as part of all alternatives developed for the EIS analysis. To support decision-making during development of an interlocal agreement and implementation of the SR 520 corridor TDM program, there was a need for more detailed, quantitative information about the effectiveness of TDM and land use strategies in the corridor. Out of this need, the Modeling TDM Effectiveness project was funded by the Federal Transit Administration and WSDOT in 2001 and the Federal Highways Administration in 2002.

Project Structure

This project is made up of two major elements:

- Development of the analytical tool (the TDM Effectiveness Estimation Methodology, or TEEM)
- Application of TEEM to 10 case study areas in the SR 520 corridor

The analytical tool, known as the TDM Effectiveness Estimation Methodology, or TEEM, is highly detailed and can assist decision-makers, planners, or others developing TDM programs or implementation plans in the SR 520 corridor. Alternative packages of TDM strategies can be tested at the neighborhood or subarea level, allowing the user to quickly identify a package of potentially effective strategies for the area. TEEM was designed to be user-friendly and accessible, recognizing that many of its potential users are not necessarily familiar with traditional travel demand modeling.

Characteristics of TEEM

Forecast year is 2030

Focuses on commute trips

Works at the neighborhood/subarea level

Estimates incremental change in travel characteristics

Based on historical rates of effectiveness

Majority of data from King County

The 15 TDM strategies included in TEEM are based on program elements of the TDM Program developed for the SR 520 EIS. Since there is a high percentage of commute trips crossing the SR 520 bridge in both the AM and PM peak periods, the strategies are focused primarily on commuter incentive-based strategies. TEEM can test the following 15 TDM strategies individually and in combination:

1. Vanpooling
2. Alternative Mode Subsidy
3. CTR-Type Programs for Smaller Employers
4. Telecommuting
5. Compressed Work Week
6. Multi-Employer Transportation Management Associations (TMAs)
7. Increased Density near Transit Corridors
8. Increased Mixed-Use Development
9. Increased Infill & Densification
10. Improved Bicycle Access
11. Improved Pedestrian Access
12. Restricted Parking Supply
13. Parking Pricing at Employment Sites
14. Flexpass/Residential Pass
15. Increased Transit Service

TEEM estimates the change in commute travel behavior in the year 2030 that would result from implementation of one or more of the above strategies within a study area and on the SR 520 corridor. The performance measures used in TEEM to evaluate TDM strategy effectiveness are based on the SR 520 TDM Program's primary goals to reduce growth of vehicle miles traveled in the overall SR 520 corridor and to increase person-throughput on the bridge. Five performances measures are used in TEEM, providing a broad perspective on how each strategy affects travel patterns:

- Commute Trip Drive Alone Mode Share
- Daily Commute Vehicle Trips
- Daily Commute Vehicle Miles of Travel (VMT)
- P.M. Peak-Period Commute Vehicle Trips
- P.M. Peak Period Person Throughput on the SR 520 Bridge

The TEEM software works off of existing model outputs, predicting the change from a year 2030 base level of TDM and land use (reflected in baseline mode shares and vehicle trip linkages).

TEEM was set up and calibrated using ten case study areas within the SR 520 corridor. The ten areas were selected to represent a variety of area types, travel patterns and TDM markets. Each of the case study areas can thus be used as a prototype for other similar areas in the corridor that were not selected as case study areas for this project. The study areas, listed below, also served as an illustration of TEEM's applicability:

Seattle
- University District
- South Lake Union
- Wallingford

Redmond
- Downtown Redmond
- Willows Road

Kirkland
- Downtown Kirkland
- Totem Lake

Bellevue
- Downtown Bellevue
- Crossroads

King County
- Redmond Ridge

TEEM is based on reported experiences with TDM and land use strategies, primarily from within King County, the county in which the SR 520 corridor is located. National research was used when local data was limited or not available. The project team relied heavily on data collected in King County for the state's Commute Trip Reduction (CTR) program. The database is an excellent source of information on TDM effectiveness, providing roughly ten years of history for over 500 employers in King County who employed roughly 120,000 employees in 2001.

Though the purpose of the project was ultimately to provide information directly relevant to the SR 520 corridor, TEEM was developed in a way that could support other similar corridor or sub area analyses in the future within King County and the Central Puget Sound region. Future corridor studies, primarily the I-405 Congestion Relief Program, will offer additional opportunities to use TEEM to evaluate TDM strategies.

The effectiveness factors developed for TEEM can easily be applied to evaluate TDM strategies in other corridors, activity centers, or neighborhoods in King County. The model is structured to use travel activity data from a local model and the regional model for calibration, so any activity center or neighborhood in King County for which local model zones are consistent with (or can aggregate to) PSRC model zones can easily be added into TEEM. Given the availability of data from Pierce, Snohomish, and Kitsap Counties (the other counties in the Central Puget Sound Region), TEEM can be expanded to include other study areas or corridors in the region.

It is also possible to estimate the potential effectiveness for an intermediate year (between now and 2030) by assuming a proportional amount of growth in population, employment and trip ends from the 2000 base and adjusting the baseline data in TEEM accordingly. However, as discussed in the following section, some strategies are better suited than others for achieving short-term effectiveness, and so attempts to test strategies in less than a fifteen or twenty-year time frame should be done with sensitivity to the temporal differences between strategies.

Results

To test TEEM in the ten study areas, five TDM strategies were applied in each area (for a total of 50 strategy applications). Each of the fifteen strategies was tested at least once as indicated in the table below. This allowed the study team to begin examining the effectiveness of individual strategies and how that effectiveness varied across applications.

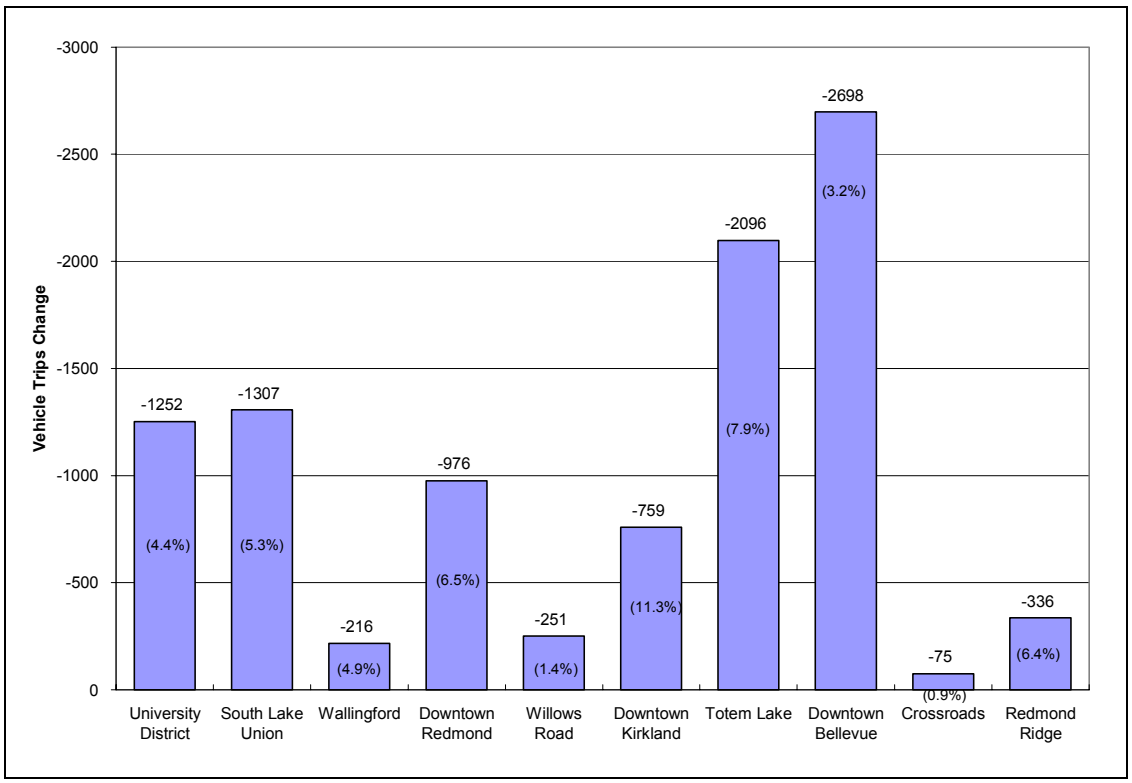
The testing of TDM strategies in this project was limited by budget to 50 strategy applications, but in future applications of TEEM, it is important to remember to consider that an optimal package of strategies may well include more than five strategies in a study area. It is also important to consider how the various strategies work together. A well-designed package that includes financial incentives, alternative modes, supportive land use and promotion and coordination will have the best chance of meeting corridor goals. In the case of some TDM strategies, particularly parking pricing, corridor-wide consistency may be needed to avoid conflicts or competition between different sub areas or jurisdictions. It is also necessary to consider the time frame necessary to fully implement each strategy. Some, such

as the employer-based strategies, will be able to be effective in the short term while others, such as the land use or parking pricing strategies, will require more time for implementation and therefore will require a longer time frame to be effective.

Strategies Tested by Case Study Area

Case Study Area	Vanpooling	Alternative Mode Subsidy	CTR-Type Programs for Smaller Employers	Telecommuting	Compressed Work Week	Multi-Employer TMA	Increased Density Near Transit Corridors	Increased Mixed-Use Development	Increased Infill & Densification	Improved Bicycle Access	Improved Pedestrian Access	Restricted Parking Supply	Parking Pricing at Employment Sites	Flexpass/Residential Pass
Seattle														
1 University District	·	●	●	·	·	·	●	·	·	●	·	·	●	·
2 South Lake Union	·	●	·	·	·	●	·	●	●	·	·	·	·	●
3 Wallingford	·	●	●	·	·	●	·	·	·	●	·	·	·	●
Redmond														
4 Downtown	●	·	·	·	·	·	·	●	·	·	●	●	●	·
5 Willows Road	●	●	·	●	·	·	●	·	·	●	·	·	·	·
Kirkland														
6 Downtown	·	·	·	●	·	●	·	·	·	·	·	●	●	●
7 Totem Lake	●	·	●	·	·	●	·	·	·	·	·	·	●	●
Bellevue														
8 Downtown	·	●	·	·	·	·	●	●	●	·	·	·	●	·
9 Crossroads	·	●	·	·	·	·	●	●	●	·	·	·	·	●
King County (unincorporated areas)														
10 Redmond Ridge	●	●	·	·	●	·	·	·	·	●	·	·	·	●
TOTAL	**4**	**7**	**3**	**2**	**1**	**4**	**4**	**4**	**3**	**4**	**1**	**2**	**5**	**6**

Predicted Reductions in Daily Commute Vehicle Trips by Study Area Employees



In addition, the application of TEEM to the ten case study areas suggested that five strategies would be most effective overall:

Parking Pricing at Employment Sites was the most effective strategy overall, and was most effective in study areas where the year 2030 baseline parking price was low or zero and where there were alternative modes available for commuting. Analysis of an additional $2 to $3 parking fee indicated that it could produce a reduction in commute trips of up to 9.8% to and from individual study areas where tested.

Increased Infill & Densification entailed reallocating growth from one part of the study area to another in order to create pockets of higher density. This strategy showed potential for significant effectiveness in areas where high growth was expected but planned for fairly even distribution across the study area. TEEM predicted this strategy could result in up to a 4.4% reduction in commute trips to and from individual study areas where tested.

Increased Mixed-Use Development, which redirected future growth in a study area to create a greater mix of residential and retail development around employment sites, also proved to be highly effective. This strategy was most effective when the baseline growth forecast reflected highly segregated uses, and produced a reduction in commute trips of up to 2.8% for individual study areas.

Multi-Employer TMAs demonstrated a potential effectiveness of up to 1.8% reduction in commute trips by study area employees for individual study areas, and was most effective when the study area contained a large number of employees covered by the CTR requirements.

Alternative Mode Subsidy was most effective in those case study areas where the base alternative modes shares (carpooling, vanpooling, and transit) were already fairly high, indicating the viability of alternative modes in that area. The analysis of this strategy indicated a potential effectiveness of up to 1.6% reduction in commute trips for study area employees to and from individual study areas where tested.

Recommendations

TEEM's development demonstrates that TDM's role in major corridor studies can be evaluated using data from regional and national experiences with such strategies. To complete the analysis for the SR 520 corridor, it is recommended that TEEM be used to test the potential effectiveness of additional TDM and land use strategies in each of the case study areas and to test the potential in the remaining employment centers in the corridor.

The results from the testing of strategies in the ten case study areas suggest that the most effective approach will be a combination of strategies that provide:

- Pricing
- Transit & Non-motorized Supportive Land Use
- Promotion/Coordination
- Alternative Mode Options

Such a combination of strategies would work together supportively and could be tested in all of the case study areas. Other areas in the SR 520 corridor that could be evaluated include the following:

Seattle

- Northgate
- Downtown
- First Hill

Kirkland

- Juanita
- Carillon Point

Bellevue

- Factoria
- Bel-Red/Northup
- Eastgate
- Lakemont

Redmond

- Southeast Redmond
- Northeast Redmond
- Grasslawn
- Overlake

Although TEEM represents a significant step forward in modeling TDM strategies, it is a work in progress. The following enhancements could improve TEEM's ability to fully quantify the effectiveness of TDM strategies:

- Revision of the way land use strategies are analyzed to allow testing of strategies on a corridor-wide basis rather than just within a subarea.
- Automation of the process of transferring data from the local and regional models to TEEM when new areas are to be added or new forecast years tested.
- Adding more strategies, such as non-commute strategies
- Expand effectiveness factors beyond historical trends to include market potential from such sources as the regional vanpool market study
- Expanding TEEM's capability so that it can estimate a full corridor program at a corridor level

TEEM's development relied heavily on the rich data provided by the state's Commute Trip Reduction database. Continued use and maintenance of this database could provide a consistent source of information on TDM effectiveness within King County, the Puget Sound region, and statewide. If resources permit, additional effort could be devoted to making sure that data received from the employers are verified and recorded accurately. Consideration might also be given to requesting more detailed employer cost information, which would allow information on cost effectiveness to be incorporated into TEEM.

Finally, it is recommended that a system for monitoring the effectiveness of TDM strategies be designed and implemented to provide information on how well strategies are working. A monitoring system can be used to refine the strategies by adjusting the way the strategies are being implemented, or to determine whether additional strategies may be needed to meet subarea or corridor-wide goals. The data from the monitoring system may also be useful for refining TEEM over time, providing more information with which to re-estimate local effectiveness factors.

Recommendations Summary

Components of an Effective Corridor TDM Strategy

- *Pricing*
- *Transit & Non-motorized Supportive Land Use*
- *Promotion/Coordination*
- *Alternative Mode Options*

Additional Analysis in SR 520 Corridor

- *Test additional strategies in study areas*
- *Test other employment centers in corridor*

Enhance TEEM

- *Revise analysis method to allow testing of land use strategies on a corridor-wide basis*
- *Automate data transfer process from models*
- *Add more strategies, including non-commute strategies*
- *Expand effectiveness factors to include market potential*
- *Further verify CTR data and add data for other counties in the region*
- *Expand capability of TEEM to estimate a full corridor program at a corridor level*

Establish a TDM Effectiveness Monitoring System for the Region

1. Introduction

1.1. Project Background

SR 520 is one of the main Washington state roadways connecting the City of Seattle with other cities such as Bellevue, Redmond and Kirkland on the east side of Lake Washington. Extending from I-5 in Seattle at its western terminus to the City of Redmond at the east, this corridor includes the Evergreen Point Floating Bridge, one of two bridges crossing Lake Washington.

The highway corridor is already heavily congested during commute hours, and the congestion is expected to worsen significantly over the next twenty years. Furthermore, the floating bridge portion of SR 520 is approaching the end of its useful lifespan. The bridge and its approaches are vulnerable to storm and earthquake risk and are in need of replacement. Two recent studies by the Washington State Department of Transportation (WSDOT) have addressed these and other issues with SR 520. The Trans-Lake Washington Study (1998-1999) convened a committee of stakeholders from communities along the corridor to look at improvement options for the SR 520 corridor, as well as other options for travel improvements across Lake Washington, including the I-90 bridge (the other bridge across the lake) and other north-south routes around the lake. In 1999-2002, the Trans-Lake Washington EIS focused on the SR 520 corridor, and identified and evaluated alternative investment options, and began to develop a plan for increasing mobility across the lake. In November 2002, due to funding cuts, the scope of the SR 520 EIS was narrowed to looking at the critical first phase of the project, focusing on bridge replacement and HOV improvements from the bridge approaches just east of the Montlake interchange to the bridge's touchdown in the Points communities.

1.1.1. TDM in the SR 520 Corridor

TDM and land use actions have played a significant part in both the Trans-Lake Washington Study and SR 520 EIS. The Trans-Lake Washington Study included the recommendation that interlocal agreement(s) should be developed to implement TDM and land use measures in the Trans-Lake Washington corridors. This recommendation was among a set of recommendations signed by study participants at the end of the study, and set the stage for a collaborative effort to develop a corridor agreement that will integrate TDM and land use goals and actions with the transportation provisions of the preferred alternative in the SR 520 EIS. The EIS included a significant TDM element as part of all alternatives, including the interlocal agreement as the preferred implementation mechanism. Appendix A provides more detail on the TDM program developed for the SR 520 EIS.

The concept for the agreement will evolve as it is developed, but it is expected to set TDM goals for the corridor and provide a framework for deciding which TDM, land use and transportation actions best support the goals. A monitoring and evaluation program will enable those implementing the agreement to assess results and outcomes, allowing programs to evolve over time.

1.1.2. The Implementing Corridor TDM Programs Project

WSDOT and grant partners have initiated the Implementing Corridor TDM Programs project jointly in order to support the development of a TDM and land use implementation plan(s) and corridor agreement(s) for the SR 520 and I-405 corridors. Funding to conduct this project was provided by a Transportation Community System Preservation (TCSP) grant from the Federal Transit Administration (FTA) in 2001 with local match provided by WSDOT, and from a second TCSP grant from the Federal Highways Administration (FHWA) in 2002.

The *Implementing Corridor TDM Programs* project contains three major elements:

- Modeling TDM Effectiveness
  - Development of the TDM Effectiveness Estimation Methodology (TEEM)
  - Case Studies for the SR 520 and I-405 Corridors
  - Refinements and enhancements to TEEM
  - Travel Behavior-Land Use Correlation Analysis
  - Non-Work and Non-Traditional Commute Trip Research
- Draft Interlocal TDM and Land Use Agreement for the SR 520 and I-405 Corridors
- Implementation Plan for the SR 520 and I-405 Corridors

A flowchart illustrating the relationships between the major tasks within the Implementing Corridor TDM Programs project can be found at the beginning of this report.

The focus of this report is on the development of the TDM Effectiveness Estimation Methodology (TEEM) and the Case Studies for the SR 520 Corridor. The report documents the methodology used to develop the TEEM software, outlines the effectiveness of the various TDM and land use practices, and provides recommendations for the development of TDM packages for different activity center and market types along the SR 520 Corridor.

Grant Partners for this portion of the project include:

- Washington State Department of Transportation
- Puget Sound Regional Council
- King County (including King County Metro)
- Sound Transit
- The Cities of Bellevue, Kirkland, Redmond and Seattle
- 1000 Friends of Washington

1.1.3. The TDM Effectiveness Estimation Methodology (TEEM) and the Case Studies

In this portion of the Implementing Corridor TDM Programs Project, the focus was on developing tools that could be used to quantify the effects of TDM strategies. There were several reasons for this focus. In order to develop a corridor agreement to implement TDM

and land use actions in the SR 520 corridor, signatory parties will need to be comfortable signing off on goals and actions. By enhancing the ability to estimate the effectiveness of various TDM and land use strategies in the corridor, TEEM and the Case Studies support decision-making during the development of TDM, land use and transportation goals, actions and measures. TEEM can also be used in the development of construction mitigation plans and an implementation schedule for the corridor, and by TDM providers for testing various packages of TDM strategies for short-term or long-term TDM goals. The use of TEEM over time also offers an opportunity to develop more specific quantitative information on TDM strategies, which can be monitored and evaluated against future empirical data and used to help calibrate local and regional travel models.

Drawing primarily on local data sources, including Washington State's Commute Trip Reduction (CTR) program, TEEM is a post-processing model that can estimate the effectiveness of 15 TDM and land use strategies along the SR 520 corridor. TEEM is based on and tested in 10 case study areas in the SR 520 corridor that illustrate a variety of urban environments and market conditions. The Case Studies can also be used to illustrate the use of TEEM for future users by providing examples of input requirements and outputs.

Upcoming work will further refine TEEM with better data, more research, and more TDM strategies. TEEM will also be expanded to include case studies and the ability to estimate effectiveness in the I-405 corridor. In addition, work on TEEM and the Case Studies has been supported by related projects conducted by the WSDOT, King County and the Puget Sound Regional Council (PSRC).

1.1.4. Draft Interlocal Agreement

The agreement will be developed cooperatively by WSDOT and the other participants in the Trans-Lake EIS, including the Puget Sound Regional council and other local jurisdictions and agencies in the corridor, plus other stakeholders such as community groups and employers and Transportation Management Associations. The development of a corridor-wide interlocal agreement to implement TDM and land use actions will likely occur in phases, and will need to take place in a way that is flexible and responsive to the different environments, markets and TDM needs of the jurisdictions and transportation agencies along the corridor.

The development of an interlocal agreement will provide a framework for setting TDM implementation goals in the SR 520 corridor, provide a list of actions that support meeting the goals, and determine the agreement funding, management and oversight, and monitoring and evaluation structures. The list of actions will be tied to the transportation provisions and TDM package from the SR 520 preferred alternative.

After the framework agreement is in place, subagreements between the agencies participating in the agreement (as well as other public and private sector organizations) will actually implement TDM and land use actions included in the corridor agreement. Neither the final framework agreement nor the subagreements are included in this project.

1.1.5. Implementation Plan

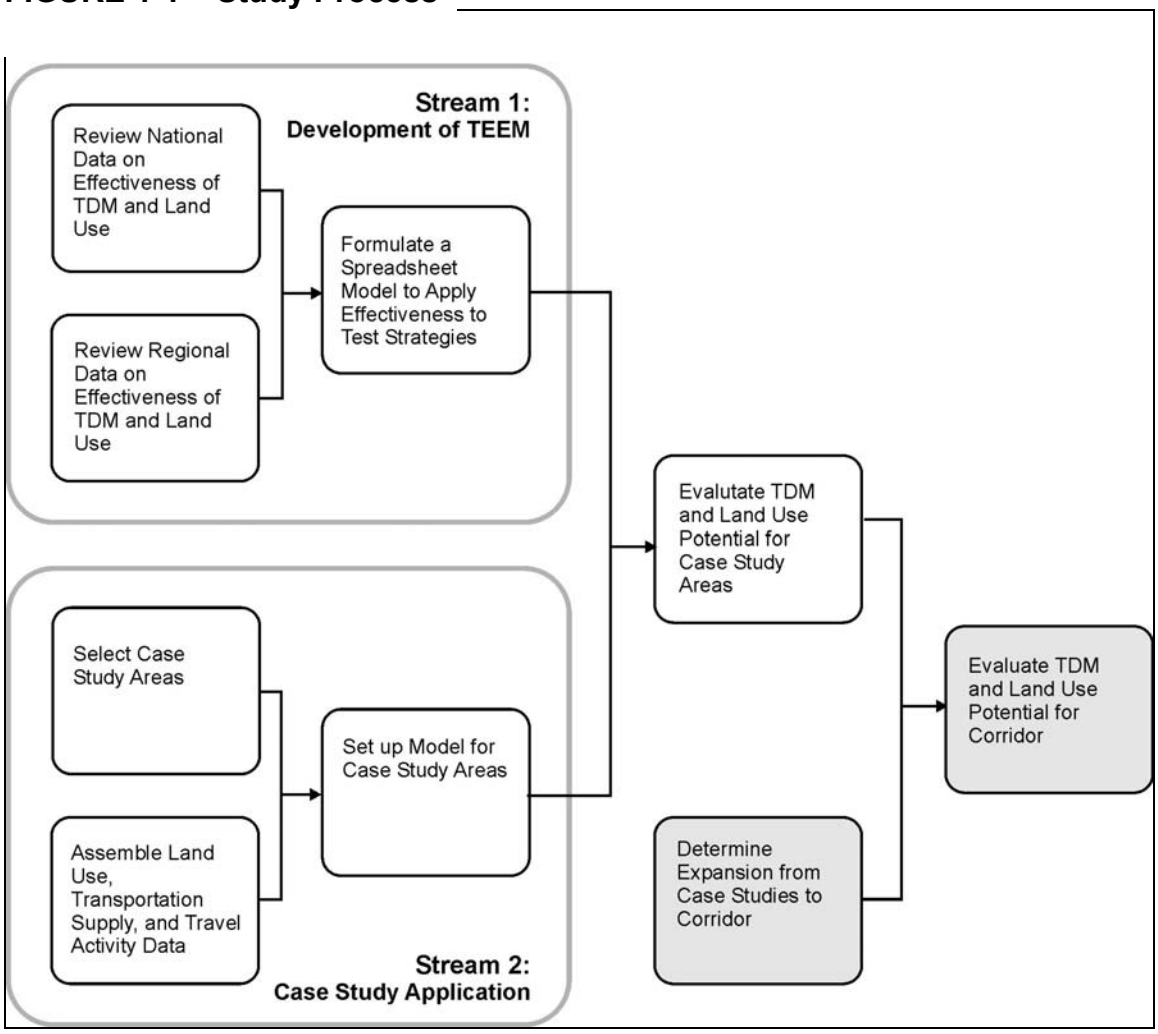
An implementation plan will be developed that outlines the interconnected actions needed to implement the TDM package from the SR 520 Preferred Alternative. The plan will be tied to the goals and actions from the corridor agreement and subagreements. The plan will identify

monitoring and evaluation processes, procedures for any necessary program adjustment, oversight structures, roles of participating agencies and organizations, and funding sources for implementation and monitoring actions. Development of the implementation plan will focus first on those practices that can be used for construction mitigation and will be tied to roadway improvement projects. The plan will also include implementation actions for those practices that support operational efficiency of the roadway and the transportation system after construction is completed. Flexibility will be built into the implementation plan so that TDM and land use actions can be adjusted in order to maintain and enhance effectiveness of the transportation system.

1.2. Project Description

This project followed a flow of work illustrated in Figure 1-1. The two main streams of work identified in Figure 1-1 were the development of the TEEM model and the assembly of information on case study areas. The combination of these two streams of work led to the evaluation of TDM and land use strategies for the ten case study areas. Ultimately the information from these two streams of work will be used to provide an overall assessment of TDM and land use potential for the SR 520 corridor. This will require an assessment of how the case study results can be expanded to reflect the corridor as a whole.

FIGURE 1-1 – Study Process



1.2.1. TEEM

Within the first major stream, TEEM's development began with the review of TDM and land use strategy effectiveness. National reviews were already available from prior work by consultant team members and from other recently completed national reviews. This was supplemented with some additional effort by the project team (WSDOT staff and the consulting team) to identify recent information being reported on strategy effectiveness. Most of the work reviewed relating to TDM and land use effectiveness focused on King County. The primary source for effectiveness information came from the data collected as part of the state's Commute Trip Reduction (CTR) program. This included:

- Information about the baseline commute travel patterns for employees of the participating companies
- History of new strategies implemented by those companies since becoming CTR employers

- Semiannual employer travel surveys, beginning with the employer being brought into the program

The resulting database provides an extensive history for almost 120,000 employees (roughly 500 employers) and how they responded to a wide variety of commute trip reduction strategies.

Although the CTR database was the primary source of information on TDM effectiveness in King County, information was also available on a more limited basis from traffic mitigation programs maintained by several cities in the SR 520 corridor. These programs provided CTR-like reports on new or expanded programs implemented by affected employers, and some information about the effectiveness of those programs. Other data were also provided on regional efforts to promote and expand transit fare subsidies through the Flexpass program and marketing and provisioning of vanpool services.

Information about the effectiveness of land use strategies was derived from the regional modeling database maintained by the Puget Sound Regional Council (PSRC). In this effort, all of the regional traffic analysis zones were classified as high, medium, or low with respect to three land use characteristics: density, land use mix, and density near high frequency transit services. Vehicle trip rates within the traffic zone were then correlated with the land use characteristics to identify patterns of how vehicle trip rates might change with changes in these three characteristics.

Based on the extensive review of TDM and land use strategy effectiveness, the TEEM model was formulated to use the information about effectiveness to predict commute travel pattern changes in a future forecast year (2030) environment. Once the methodology had been formulated in TEEM, the model was set up and calibrated for the ten case study areas by drawing upon the PSRC model (as modified for the Trans-Lake Washington EIS) and the local area models for the case study jurisdictions.

1.2.2. The Case Studies

Work in the second stream of work, the Case Studies, began with consideration of nineteen potential case study sites selected by the project team and members of the project's Advisory Committee. From the nineteen potential case study areas, the Advisory Committee selected ten to represent the variety of activity centers in the SR 520 corridor. The intent was to select sample case study areas that could be used to develop effectiveness factors. Those factors could then be used for other activity centers in the corridor and, in doing so, provide an ability to expand from the case study analysis to a corridor-wide estimate of future TDM and land use strategy effectiveness.

In this project, all of the steps in the flow chart in Figure 1-2 have been completed except for the two shaded boxes, which represent the expansion of the analysis to the whole corridor. In order to truly understand the impact of a TDM program along the entire corridor, it will be necessary to complete this next step. Chapter 3 (Results and Recommendations) provides more detail on how this portion of the analysis might be completed.

2. The Development of TEEM and the Case Studies

This chapter describes TEEM's development and the preparation of the ten case studies, including a description of the process that was used to complete these tasks. It identifies all of the options that were considered and how decisions were made about final structuring of TEEM and the case study applications and reports. A thorough description of TEEM's analytical framework is provided, including a description of the TDM strategies, case study areas and performance measures; the method used to evaluate strategy effectiveness; the data used to reflect current and future baseline conditions: the analysis years: and how the impact of multiple strategies was tested. This overview of the analytical framework for TEEM is followed by a description of the research on strategy effectiveness. This includes citations of the work with the CTR database for King County and other regional sources of TDM and land use effectiveness, as well as a summary of the national literature review of TDM and land use effectiveness. A final section in this chapter provides a description of the data used to represent the ten case study areas in King County.

2.1. The Process

The development of TEEM and the Case Studies took place over a sixteen-month period between November 2001 and February 2003. The project team included staff from the TDM Resource Center of the Washington State Department of Transportation (located within WSDOT's Planning and Policy Office) and a consultant team lead by DKS Associates, with assistance from Mirai Associates.

An Advisory Committee was formed to give technical and policy input, consisting of staff from the five local jurisdictions in the SR 520 corridor: Seattle, Kirkland, Redmond, Bellevue and King County (representing only the unincorporated portions of the corridor). The Advisory Committee also included representatives from WSDOT's Olympia TDM Office, the Puget Sound Regional Council, King County Metro, Sound Transit, and 1000 Friends of Washington. The Advisory Committee met seven times to provide guidance on the project with the following issues addressed in those meetings:

Meeting 1 - Project Scope and Consultant Contract Scope
Meeting 2 - Case Study Areas and Strategies to be Analyzed
Meeting 3 - Analytical Framework, Forecast Years, Performance Measures, and Strategies to be Analyzed in each Case Study Area
Meeting 4 - Analytical Methodology and Strategy Effectiveness Research Results
Meeting 5 - Initial Results of TEEM Application
Meeting 6 - Refinement of Teem and Second Round of Results
Meeting 7 - Final Report and Case Study Documentation

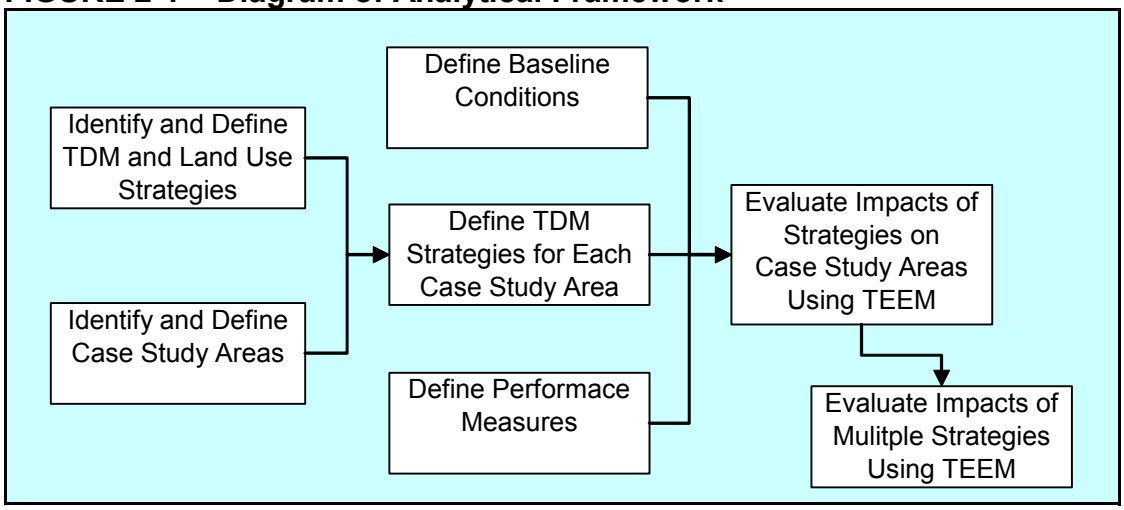
2.2. Analytical Framework

The TEEM model focuses on the trip reduction of commute trips both to and from each case study area. The review of information on the effectiveness of programs on non-commute trips

produced insufficient evidence to develop and justify trip reduction estimates for these trips, so TEEM's focus was limited to employed residents and employed workers in the case study areas.

The analytical framework used to develop TEEM is illustrated graphically in Figure 2-1. The development of TEEM began with defining the set of strategies that would be included and the case study areas in which TEEM would be tested. This led to the definition of TDM strategies for each of the case study areas. Baseline conditions for each of the case study areas were defined and performance measures were selected. When combined with research on the effectiveness of TDM and land use strategies, these steps led to the development of the TEEM software. TEEM was then used to evaluate the impacts of individual strategies on the case study areas. Impacts were evaluated individually and in combination, recognizing the non-linear effects of strategies when combined. Each of these elements is described in greater detail in this section.

FIGURE 2-1 – Diagram of Analytical Framework



2.2.1. Identifying and Defining TDM and Land Use Strategies

The process for identifying and defining TDM and land use strategies to be considered for inclusion in TEEM began with a review of strategies included in other analytical tools developed by the consulting team. These included:

1. TCM Tools - a methodology designed to test 30 demand management measures when applied on an area-wide basis.
2. CM/AQ Analysis Tool - a methodology to test 59 potential congestion mitigation or air quality improvement project types when applied in a specific project setting.
3. Transportation/Land Use Analysis Tools – a methodology designed to test 9 potential transportation/land use strategies designed to reduce trips, VMT and pollutant emissions.
4. ECO Checklist – a methodology designed to test 15 employer-based trip reduction strategies in a specific environment employment and land use setting.

The composite lists of strategies from these four previous tools were combined into a listing of strategies covering the five areas used in the description of the TDM program for the SR 520 EIS:

1. Vanpooling
2. Public Information and Education
3. Employer-based Programs
4. Land Use as TDM
5. Other Miscellaneous TDM Programs

The initial list of strategies in these categories was reviewed by the WSDOT staff and the members of the Advisory Committee, resulting in the list in Table 2-1. Table 2-1 provides an assessment of each strategy on a basis of three criteria:

- Amount of local existing local data
- The extent to which the strategy reduces commute trips during peak periods.
- Overall corridor applicability

From this list of 57 strategies, the Advisory Committee and project team selected 15. The strategies were selected using four criteria:

- Represent the full range of TDM program elements listed above
- Availability of local data on effectiveness
- Potential for reducing commute trips during peak periods
- Potential for reducing vehicle trips in the SR 520 corridor

TABLE 2-1 – Strategies Recommended for Consideration

Strategy (Analytical Tool)	Amount of Existing Local Data	Reduces Peak Period Trips	Corridor Applicability
1. Vanpooling			
Provide Vans (strategies should focus on publicly provided vans)			
Vanpool Programs (CM/AQ)	High	Yes	High
Company Vans w/fee (ECO)	High	Yes	High
Company Subsidized Vans (ECO)	High	Yes	High
2. Public Information and Education			
Coordinated Major Campaigns			
Public Education Campaign for Non-Motorized Facilities (CM/AQ)	Low	Yes	Low
Centralized Traveler Information Service			
Transit Advanced Traveler Information System (CM/AQ)	Low	Yes	Medium
3. Employer-Based Programs			
CTR Incentives & Resources			
Employee Transportation Coordinator (CM/AQ)	Medium	Yes	High
Employer Education/Information Dissemination (CM/AQ)	Medium	Yes	High
Guaranteed Ride Home (CM/AQ)	Medium	Yes	Medium
Bicycle Amenities (CM/AQ)	Low	Yes	Medium
Bicycle/Pedestrian Coordinator Positions (CM/AQ)	Medium	Yes	Low
Full Transit Pass Subsidy (ECO)	High	Yes	High
1/2 Transit Pass Subsidy (ECO)	High	Yes	High
Eliminate Parking Subsidies (ECO)	Low	Yes	Medium
Reduced Parking Cost for HOVs (ECO)	Low	Yes	Medium
Full Alternative Mode Subsidy (ECO)	Medium	Yes	High
1/2 Alternative Mode Subsidy (ECO)	Medium	Yes	High
Bicycling Program (ECO)	Low	Yes	Medium
On-Site Rideshare Matching (ECO)	Medium	Yes	High
Gifts/Awards for Alt Mode Use (ECO)	Low	Yes	Medium
Provide Buspools (ECO)	Low	Yes	Medium
Walking Program (ECO)	Low	Yes	Low
Time off for Alternative Mode Use (ECO)	Low	Yes	Low
Company Cars for Business Travel (ECO)	Low	Yes	Low
Transportation Management Associations			
TMA Rideshare Program Services (CM/AQ)	Medium	Yes	High
Parking Cashout			
Cashout Employee Parking (ECO)	Low	Yes	High
Increase work options			
Flexible Work Hours (TCM)	Medium	Yes	High
Staggered Work Hours (TCM)	Medium	Yes	High
Home-Based Telecommuting (CM/AQ)	Low	Yes	Medium
Satellite Work Center (CM/AQ)	Low	Yes	High
Teleconferencing (CM/AQ)	Low	Yes	Medium
Telecommuting: Full Time (ECO)	Medium	Yes	Medium
Telecommuting: 1-2 Days/Week (ECO)	Medium	Yes	Medium
Compressed Work Week: 9/80 Schedule (ECO)	Medium	Yes	Medium
Compressed Work Week: 4/40 Schedule (ECO)	Medium	Yes	Medium
Compressed Work Week: 3/36 Schedule (ECO)	Medium	Yes	Medium

TABLE 2-1 – Strategies Recommended for Consideration (continued)

Strategy (Analytical Tool)	Amount of Existing Local Data	Reduces Peak Period Trips	Corridor Applicability
4. Land Use as TDM			
Urban form			
Increase Density near Transit Corridors (T/LU)	Medium	Yes	High
Increase Density near Transit Stations (T/LU)	Medium	Yes	High
Encourage Mixed-Use Development (T/LU)	Medium	Yes	Medium
Encourage Infill & Densification (T/LU)	Medium	Yes	High
Develop Concentrated Activity Centers (T/LU)	Medium	Yes	High
Facilitate affordable housing (part of Jobs/Housing balance)	Some	Yes	High
Connectivity			
Bicycle Lanes, Paths (CM/AQ)	Medium	Yes	Medium
Provide Pedestrian Facilities (T/LU)	Medium	Yes	Medium
Develop Interconnected Street Network (T/LU)	Medium	Yes	High
Parking Management			
Restricted Parking Supply (CM/AQ)	Medium	Yes	Medium
Preferential Parking for Carpools and Vanpools (CM/AQ)	Medium	Yes	High
Provide Strategic Parking Facilities (T/LU)	Medium	Yes	High
5. Other/Miscellaneous TDM Programs			
Innovative HOV Fare Media			
Regional/Neighborhood Based Rideshare Program (CM/AQ)	Low	Yes	Medium
Activity Center Shuttles (CM/AQ)	Low	Yes	Medium
Expand carsharing	Medium	Yes	High
Flexpass	High	Yes	High
Non-Commute Trip TDM			
Non-Commute Trip Reduction Ordinances (TCM)	Low	No	Medium
Non-Commute Parking Pricing (TCM)	Medium	No	Medium
New Park & Ride Leased Lots/SLUG			
Car/Vanpool-oriented (CM/AQ)	Medium	Yes	High
Bike to Park-n-Ride Program (CM/AQ)	Low	Yes	Low
Freight Management Programs			
Delivery Timing (TCM)	Low	Yes	High
Loading Facility Improvements (TCM)	Low	Yes	Medium

The final set of strategies selected for inclusion in TEEM was as follows:

1. ***Vanpooling*** – An organized, promoted and subsidized vanpool program offered to an additional increment of employees within a study area above and beyond the employees that would already be offered the vanpool program in the baseline condition for 2030. The increment of employees may come from new employers offering programs to employees for the first time or from employers who already offer vanpooling to some employees offering it to more employees. The subsidy is assumed to be the same as the average 2001 subsidy by CTR employers (organized by number of employees) that indicated that they provide a subsidized vanpool program.
2. ***Alternative Mode Subsidy*** – A direct subsidy paid by the employer to the employee for commute modes other than "Drive Alone". This may include transit, vanpooling, carpooling, bicycling or walking.

3. ***CTR-Type Programs for Smaller Employers*** – Providing non-CTR affected employers with planning, reporting and monitoring support to support meeting the goals of Washington's Commute Trip Reduction law. This strategy will include only a planning, reporting and monitoring program and not any of the services or subsidies that might be offered by or through the employer to support meeting the CTR goals.
4. ***Telecommuting*** – An allowance by employers for employees to work at home for one or more days a week. The strategy will assume that employees use their own personal computer, telephone and other equipment at home and provide their own Internet service provider or other service necessary to communicate from home.
5. ***Compressed Work Week*** – An allowance by employers for employees to complete a full work period in less than the number of regular workdays during that period. Two types of compressed work weeks will be analyzed: 4/40, in which a full work week is completed in four work days and 9/80, in which two full work weeks are completed in nine work days.
6. ***Multi-Employer Transportation Management Associations (TMAs)*** – An employee transportation coordinator (ETC) working with the multiple companies, ridesharing promotional materials, and coordination of ride-matching services with Metro and other regional agencies that provide ride matching.
7. ***Increased Density Near Transit*** – An increase in the previously assumed densities along bus routes, near regional transit centers or near future high capacity transit stations.
8. ***Increased Mixed-Use Development*** – Alters existing land use forecasts to reflect a greater mix of complementary land uses within the case study areas. Complementary land uses are considered to be those that together reduce vehicle trip demand while not reducing person trip demand. This includes mixing of residential land use with commercial land use to provide residents with employment and shopping within a short distance.
9. ***Increased Infill Development and Densification*** – An increase in the previously assumed land-use forecasts to concentrate more employment and higher density housing in the existing activity or urban centers within each study area.
10. ***Improved Bicycle Access*** – An increase in the network of bicycle routes (a combination of bicycle lanes in the street right-of-way and separate off-road paths). The analysis of this strategy is based on an assessment of how comprehensively the study area is connected via safe and pleasant bicycle routes or paths with the area within six miles of the outer edges of the study area. An increase in bicycle connectivity can also result from increasing the street connectivity in or around the study area, which can create new bicycle routes. The assessment is largely a subjective one and is designed to relate the situation being tested for the study area to maximum bicycle route/path connectivity in the Puget Sound Region.

11. ***Improved Pedestrian Access*** – Improving the network of sidewalks and trails and other pedestrian facilities. The analysis of this strategy is based on an assessment of how comprehensively the study area is connected via safe and pleasant sidewalks or other pedestrian facilities with the area within one mile of the outer edges of the study area. An increase in pedestrian connectivity can also result from increasing the street connectivity in or around the study area, which can create new pedestrian routes. The assessment is largely a subjective one and is designed to relate the situation being tested for the study area to the maximum pedestrian connectivity in the Puget Sound Region.
12. ***Restricted Parking Supply*** – Imposition of maximum parking ratios for future development to where they do not exist and lowering the maximum ratios where they do exist.
13. ***Parking Pricing at Employment Sites*** – Charging for parking at employment sites. This may take the form of an elimination of free parking, with the employer requiring some payment for on-site parking, or may include the offering of all parking to the public at a fee with few or no spaces reserved specifically for employees of the building or site.
14. ***FlexPass/Residential Pass*** – Offering a transit pass to all members of a group at a reduced rate. The group may be an employer, all of the employers within a TMA, or a residential neighborhood.
15. ***Increased Transit Service*** – More transit to a zone than is already reflected in the 2030 baseline. The increase in the transit service can be a change in mode such as replacing bus service with light rail service, can be the addition of new service, or can be an increase in the frequency of service.

In selecting the final set of strategies, there were no strategies from the second category "Public Information and Education." The view of the Advisory Committee was that Public Information and Education would be an essential element of an overall corridor-wide TDM program, but that there was not enough available data to separate out the impacts of marketing and education efforts from the overall results of TDM strategies. TEEM's results are therefore assumed to include an "average" public information/education component based on the historical level of information/education provided with programs, but a more aggressive marketing and education campaign could further increase effectiveness.

2.2.2. Identifying and Defining Case Study Areas

Ten case study areas were selected by allowing each jurisdiction on the project's Advisory Committee to identify a "short list" of potential case study areas. There locations are shown in Figure 2-1. Committee members were asked to keep in mind the need to test a variety of activity centers based on land use characteristics, travel patterns, and proximity to the SR 520 corridor. After identifying the potential study areas in each of the five jurisdictions represented on the Advisory Committee, a decision was made by the committee as a whole that Seattle would have three case study areas and unincorporated King County only one. Each of the other three jurisdictions (Bellevue, Kirkland and Redmond) would be allowed to choose two case study areas. With this agreement in place, ten case study areas were selected:

Seattle

University District – A high-density, mixed-use commercial and residential district adjacent to the University of Washington's main campus.

South Lake Union – An older, primarily warehouse and light industrial urban neighborhood adjacent to downtown that is the focus of multiple public and private redevelopment efforts.

Wallingford – An older, small-scale, medium density mixed-use urban neighborhood that is primarily residential, but encompasses a commercial street with a mix of retail and office use.

Redmond

Downtown – A suburban downtown adjacent to SR-520 with a retail focus and some developing mixed-use, residential and office areas.

Willows Road – A developing commercial, low-density, linear office center located next to (but disconnected from) a low-density residential neighborhood.

Kirkland

Downtown – An older, medium-density suburban downtown near the eastern base of the SR-520 Bridge.

Totem Lake – A suburban activity center containing a hospital, medical offices, low-density commercial and a mix of multi-family and single-family residential developments at key interchanges along I-405 roughly 5 miles north of SR 520.

Bellevue

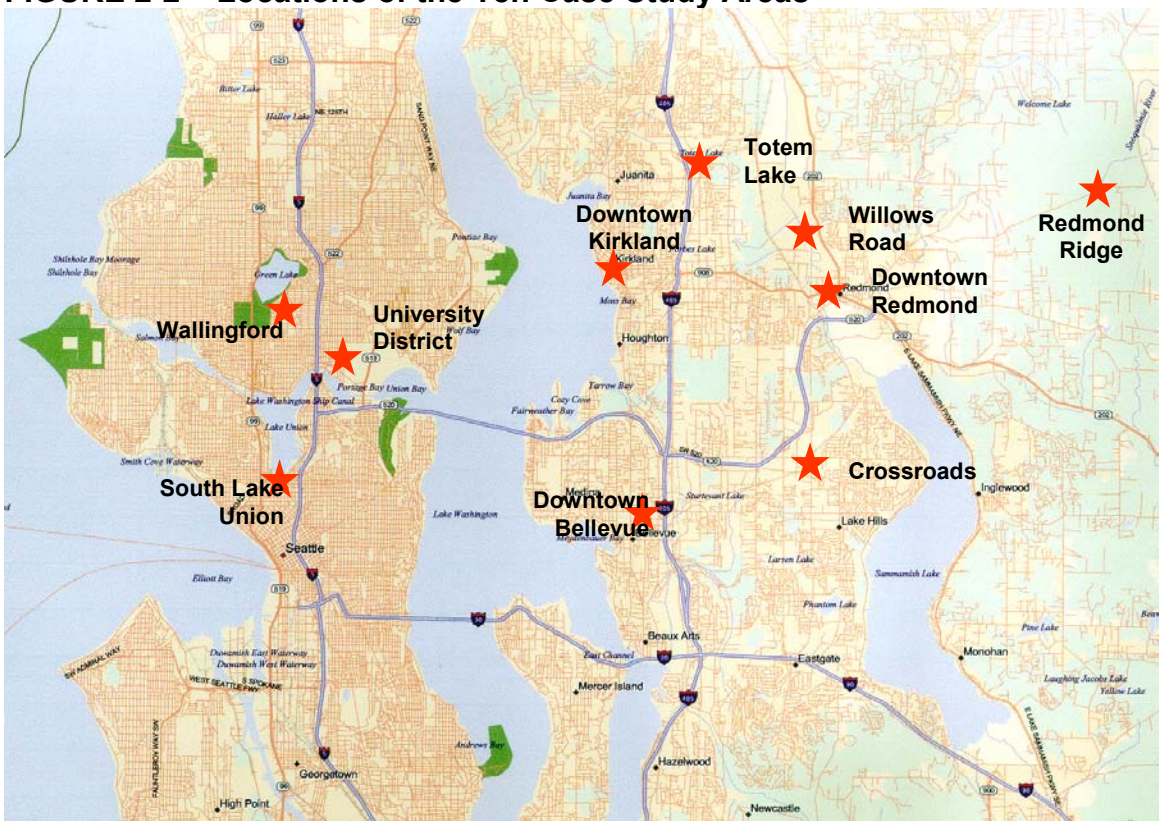
Downtown – The largest and most rapidly growing downtown on the east side of Lake Washington, located near the east end of the SR-520 Bridge.

Crossroads – An older, suburban neighborhood surrounding a shopping mall, with medium-density residential apartment development and some office commercial.

King County (unincorporated areas)

Redmond Ridge – A large, newly developing planned community that will include residential, office and retail development on the fringe of the region's Urban Growth Boundary.

FIGURE 2-2 – Locations of the Ten Case Study Areas



2.2.3. Applying TDM Strategies to the Case Study Areas

Once the list of TDM and land use strategies had been developed and the case study areas selected, a draft list of candidate strategies for each of the case study areas was developed. Budget constraints limited the total number of strategy/area applications that could be analyzed to 50, and so five strategies were analyzed in each of the ten case study areas. In preparing this list, the consulting team and WSDOT staff drew upon descriptions of the case study areas and information about strategies that had been implemented before. The initial set of candidate strategies was formulated and distributed to the Advisory Committee and refined based on comments from committee members. A final list of strategies was agreed upon in the third meeting of the Advisory Committee. Table 2-2 indicates which strategies were tested in each of the ten case study areas.

Although *Increased Transit Service* was selected as one of the measures to be included in TEEM, the strategy was not formally tested in any of the case study areas. Transit service increases were tested as part of the SR 520 EIS. For many of the other strategies to be effective, transit service will have to be available to carry trips that are shifted from driving alone, which may require an improvement in transit service to accommodate the revised demand. An increase in transit service to meet the increased demand may then also increase the transit ridership.

Recommendations were then developed to specify the level at which each strategy would be tested, for each of the case study areas where it was to be applied (for example, offering *Vanpooling* to an additional 20% of study area employees in Downtown Redmond). The

recommendations for level of implementation were based on the consultant team's knowledge of the study areas, its present and future land use characteristics, present and future travel patterns, and the extent to which TDM strategies had been implemented by CTR and non-CTR employers within the study area.

An initial list of implementation levels was formulated and presented to the Advisory Committee with an assessment of effectiveness using a draft version of TEEM. This first round of strategy analysis provided information to the individual jurisdictions and to the Advisory Committee as a whole about the likely effectiveness of each strategy. Once these initial results had been presented to the Advisory Committee, a series of one-on-one meetings were held with the Committee members to discuss the strategies, the levels at which they were tested and the TEEM model structure. Based on the discussion and these one-on-one meetings, refinements were made to the levels at which these strategies were tested and to the TEEM methodology. The final listing of levels for strategy testing is provided in Appendix B.

TABLE 2-2 – Strategies Tested by Case Study Area

Case Study Area	Vanpooling	Alternative Mode Subsidy	CTR-Type Programs for Smaller Employers	Telecommuting	Compressed Work Week	Multi-Employer TMA	Increased Density Near Transit Corridors	Increased Mixed-Use Development	Increased Infill & Densification	Improved Bicycle Access	Improved Pedestrian Access	Restricted Parking Supply	Parking Pricing at Employment Sites	Flexpass/Residential Pass
Seattle														
1 University District	·	●	●	·	·	·	●	·	·	●	·	·	●	·
2 South Lake Union	·	●	·	·	·	●	·	●	●	·	·	·	·	●
3 Wallingford	·	●	●	·	·	●	·	·	·	●	·	·	·	●
Redmond														
4 Downtown	●	·	·	·	·	·	·	●	·	·	●	●	●	·
5 Willows Road	●	●	·	●	·	·	●	·	·	●	·	·	·	·
Kirkland														
6 Downtown	·	·	·	●	·	●	·	·	·	·	·	●	●	●
7 Totem Lake	●	·	●	·	·	●	·	·	·	·	·	·	●	●
Bellevue														
8 Downtown	·	●	·	·	·	·	●	●	●	·	·	·	●	·
9 Crossroads	·	●	·	·	·	·	●	●	●	·	·	·	·	●
King County (unincorporated areas)														
10 Redmond Ridge	●	●	·	·	●	·	·	·	·	●	·	·	·	●
TOTAL	**4**	**7**	**3**	**2**	**1**	**4**	**4**	**4**	**3**	**4**	**1**	**2**	**5**	**6**

2.2.4. Defining Performance Measures

The project team and the Advisory Committee also identified transportation performance measures to keep track of reductions or changes in travel demand due to TDM and land use actions. Eight possible performance measures were identified and evaluated on the basis of the following criteria:

1. Ease with which the measure can be estimated for the candidate strategies
2. Ease with which the measure can be monitored after strategies are implemented
3. Ease with which the measure can be used to estimate the combined effect of the applied strategies
4. Degree to which the measure relates the strategy effectiveness to the project need(s)
5. Ease with which the measure can be understood in concrete terms by decision makers
6. Degree to which the measure covers all trips types that affect the project need
7. Degree to which the measure captures the full range of benefits and impacts
8. The assessment of the candidate measures in shown in Table 2-3.

Based on the evaluation of the candidate measure the following measures were selected:

- Commute Trip Drive Alone Mode Share
- Daily Commute Vehicle Trips
- Daily Commute Vehicle Miles of Travel (VMT)
- P.M. Peak-Period Commute Vehicle Trips
- P.M. Peak Period Person Throughput on the SR 520 Bridge

TABLE 2-3 – Evaluation of Candidate Performance Measures

	Pros	Cons
1.) Peak Period Vehicle Miles Traveled (VMT)	a) Directly related to project need b) Can be related to corridor capacity and LOS c) Reflects all trip types	a) Difficult to estimate accurately b) Does not capture the full range of benefits
2.) Person Throughput/Demand	a) Directly related to project need b) Captures the combined effects of strategies c) Focuses on movement of people rather than vehicles	a) Difficult to estimate accurately b) Does not capture the full range of benefits c) Not always understood buy decision makers
3.) Total Vehicle Trips	a) Easy to estimate b) Easy to understand c) Reflects all trip types	a) Does not relate to project need
4.) Total VMT	a) Easy to understand b) Relates to environmental benefits c) Reflects all trip types	a) Does not relate to project need
5.) Total VMT per Capita	a) Normalizes benefit b) Relates to environmental benefits c) Reflects all trip types	a) Difficult to identify relevant population b) Does not relate directly to project need on SR 520
6.) Commute Trip Mode Share	a) Easy to understand b) Easy to estimate c) Identifies the role of alternative modes	a) Does not relate directly to project need on SR 520 b) Captures only work trips
7.) Average Commute Trip Vehicle Occupancy	a) Provides a measure of employment traffic impact	a) Difficult to estimate accurately b) Captures only work trips
8.) Percent of Commute Trips in the Peak Hour	a) Recognizes the time sensitive nature of project need	a) Difficult to estimate accurately b) Does not relate directly to project need on SR 520 c) Captures only work trips

2.2.5. Evaluating the Impacts of Strategies on Case Study Areas

The SR 520 EIS, in developing preliminary recommendations for a corridor TDM program, produced estimates of TDM program effectiveness. Since the emphasis and total investment in TDM varied depending on the alternative, estimates of program effectiveness also vary depending on the nature of the corridor improvement. Effectiveness was estimated using three measures. The estimates are shown in Table 2-4.

TABLE 2-4 – Estimates of Potential Effectiveness of Corridor TDM Program from the SR 520 EIS

Potential Measures of Impacts on Trip-Making in the SR 520 Corridor (Examples)	Estimated as Attributed to TDM Program (may already be included in model to some degree)		
	4 Lanes	6 Lanes	8 Lanes
Reduce Growth of Daily VMT in Overall Corridor	2-5%	4-7%	3-6%
Reduce Growth of AM Peak VMT in Overall Corridor	7-12%	12-18%	10-15%
Increase Person-Throughput on Bridge	6-8%	8-10%	6-8%
Source: Transportation Demand Management Element Definition & Evaluation Report, The WSDOT TDM Resource Center and the Trans-Lake Washington Project Consultant Team			

TEEM was developed to assist WSDOT and the jurisdictions in the corridor in developing more refined estimates of the potential effectiveness of specific TDM and land use programs.

TEEM calculates the effects of strategies on trips to, from or within each study area. After this calculation has been made, the potential impact on SR 520 is predicted using model information on the percentage of vehicle trips to or from each case study area that cross the SR 520 bridge midpoint during the P.M. peak hour and on a daily basis.

All forecasts in TEEM are for the year 2030 to maintain consistency with the other forecasts prepared for the SR 520 EIS. A reasonable estimate of the potential effectiveness for an intermediate year could be developed by assuming a proportional amount of growth in population, employment and trip ends from the 2000 base and adjusting the baseline data in TEEM accordingly. Some strategies are better suited than others for achieving short-term effectiveness, however, and so attempts to test strategies in less than a fifteen- or twenty-year time frame should be done with sensitivity to this difference between strategies.

TEEM estimates the effectiveness of a strategy by applying strategy effectiveness factors to baseline data for a defined area. Whenever possible, the sensitivity factors are estimated from historical data from King County. If there is not sufficient evidence of effectiveness from King County, national research on the strategy effectiveness is used. Sensitivity factors are used to estimate the change in mode of travel or frequency of travel that will result from implementation of a TDM or land use strategy.

Characteristics of TEEM

- Forecast year is 2030
- Focuses on commute trips
- Works at the neighborhood/subarea level
- Estimates incremental change in travel characteristics
- Based on historical rates of effectiveness
- Majority of data from King County

The main source of strategy effectiveness in King County is the State of Washington's Commute Trip Reduction database. Beginning in 1993, employers with 100 or more employees have had to satisfy the requirements of the Commute Trip Reduction Law, which established procedures for reporting and implementing trip reduction programs. Every two years, CTR employers must describe the work site, the work force employed at the site, the trip reduction programs in

place at the work site and the cost of providing the trip reduction programs in place. They are also required to conduct an employee survey to determine what the commute patterns were and what modes of travel were used. The reports and survey results are available for the years 1993, 1995, 1997, 1999 and 2001. By identifying which CTR employers made changes in their programs during those years, it was possible to estimate the effect of program changes on employee commute patterns.

The main source of land use strategy effectiveness in King County is zonal land use and travel data for the case study areas. Statistical analysis was conducted on the relationship between vehicle trips per person and three land use/transportation factors: total density, density near transit services and the mix of land uses.

2.2.6. Evaluating the Impact of Multiple Strategies

The methodologies for all of the fifteen strategies are designed to operate on the same baseline travel patterns. In most cases, the cumulative effect from combining most strategies can be found by sequentially predicting the effect of one, then adjusting the baseline data and applying the next one. Strategies such as these are referred to as multiplicatively additive. Other strategies, when combined, affect different markets and the results can be combined directly. These are referred to as directly additive. This could include a strategy affecting only employee trips being combined with a strategy affecting only residential non-work trips. A third type of combination is strategies that conflict in ways that are not accounted for by readjusting the base shares. These are referred to as conflicting strategies and a correction factor must be specified to be able to estimate the combined effect of both. Similarly, the final category of strategy combination is referred to as synergistic. When combined, they produce greater results because of their supportive nature than a direct addition of their impacts would suggest.

TEEM is designed to apply sensitivity factors to base mode shares incrementally when more than one strategy is being tested. By readjusting the base mode shares, the methodology can accurately represent the first two types of interactions above: directly additive and multiplicatively additive. If the strategies do not interact or affect the same markets and are directly additive, then no adjustment of the predicted changes in necessary at all. If they are multiplicatively additive, the readjusting of the base mode share provides an accurate assessment of the combined affect but the individual effects cannot be identified. Only the conflicting and synergistic affects are not directly accounted for in TEEM. Users of TEEM should be aware of when such interaction may be occurring and special adjustments made.

2.3. The TEEM Program

2.3.1. Software

The TEEM has been programmed in an Excel spreadsheet workbook. In this format, the methodology is available to virtually everyone with a computer. It also allows maintenance and upkeep of the methodology by anyone familiar with Excel.

2.3.2. User Interface

The TEEM contains many calculations using a broad range of data sets. In most cases the input needs are quite simple. In testing a strategy scenario for one of the forecast years for

which the methodology was calibrated, most of these calculations and data sets are not changed by the user. In cases where inputs are required from the user, a simple user interface has been written to allow the user to enter in a screen template only the information needed to test a strategy.

2.3.3. Output

Output from the model is provided in two forms: a table giving the change in each of the performance measures and a file with adjusted trip ends. The summary table is useful in direct interpretation of the analysis results, but the file of adjusted trip ends can be used to modify a model trip table to reflect the effect of the strategies tested.

2.4. Research on Strategy Effectiveness

2.4.1. Application of Research Findings

The results of the local and national research on strategy effectiveness are used in the TEEM in several ways:

- To estimate a strategy's effectiveness in changing mode or time of travel to work
- To determine how effectiveness varies by employer characteristic (number of employees, type of employment, etc.)
- To determine how strategies interact when more than one is implemented
- To determine the cost of implementing programs
- To determine the travel patterns of people participating in various programs (e.g. which days employees on compressed work weeks do not work)

The factors and other travel profile data that are used in the TEEM are identified in Appendix C, which contains a full description of the calculations incorporated in the methodology and the sources of the data used.

2.4.2. CTR Data

The most important dataset for understanding the effectiveness of TDM strategies in the Puget Sound Region was the one generated from monitoring required by the Commute Trip Reduction (CTR) Program. Three different types of surveys have been conducted with businesses affected by the CTR program: a survey of employees to determine how they travel to and from work, a survey of employers to determine what TDM programs they offer, and another survey of employers to determine the cost of providing TDM programs. These surveys determine how an employer's CTR program is being implemented and how effective it is.

CTR survey data are available for 1995, 1997, 1999 and 2001. Because of a number of changes in how the employer surveys were conducted between 1997 and 1999, only two sets of changes can be assessed for employers in the CTR program: 1995 to 1997 and 1999 to 2001. The employee commute mode shares were determined for each reporting year, as well as what programs were in place in each year. The team also identified which employers made changes in programs between reporting years and how the commute mode shares changed

between those years. Table 2-5 and Table 2-6 provide summary statistics for the database as a whole, and for the six program types that are relevant for this project: vanpooling, ride-matching programs, transit subsidy, bicycle subsidy, telecommuting programs and compressed work week programs.

TABLE 2-5 – Summary of the CTR Database Characteristics

Criteria	Data
Years with Employees Commute Travel Characteristics Survey	1993, 1995, 1997, 1999, 2001
Years with Employer Program Description Survey	1995, 1997, 1999, 2001
Years with Employer Program Cost Survey	2001
Number of Employers Reporting	
1995	380
1997	430
1999	512
2001	528
Number of Employees Reporting	
1993	78,059
1995	103,615
1997	109,448
1999	117,048
2001	119,486
Employers Adopting Programs While a CTR Employer	
Vanpooling Program	129
Ridematching Program	183
Transit Subsidy	93
Bicycle Subsidy	56
Telecommuting Program	296
Compressed Work Week Program	97

TABLE 2-6 – Summary of Strategy Effectiveness from CTR Database

Program	Employers Changing only this Program		Employers Changing this and Other Programs	
	Number	Change in Drive Alone	Number	Change in Drive Alone
Vanpooling Program	7	-7.30%	122	-3.90%
Ridematching Program	23	4.30%	160	-2.00%
Transit Subsidy	3	-2.80%	90	-3.50%
Bicycle Subsidy	0	0.00%	56	-0.20%
Telecommuting Program	52	-1.20%	244	0.10%
Compressed Work Week Program	11	2.60%	86	0.20%

2.4.3. Land Use/Trip Generation Data

The main source for land use strategy effectiveness in King County was zonal land use and travel data for the case study areas. Statistical analysis was conducted on the relationship between vehicle trips per person and three land use/transportation factors: density near transit services, total density, and the mix of land uses.

All of the PSRC model system's traffic analysis zones (TAZs) were classified in one of six transit service categories based on the number of routes within a quarter mile of the TAZ. The definitions for the classification levels are illustrated in Table 2-7.

TABLE 2-7 – Transit Level of Service Definitions

Transit Service	Definition
High 1	At least one (1) rail route or five (5) or more high frequency routes
High 2	Four (4) high frequency routes or at least fifteen (15) total routes
Medium 1	Three (3) high frequency routes or at least ten (10) total routes
Medium 2	Two (2) high frequency routes or at least five (5) total routes
Low 1	At least two (2) total routes
Low 2	Less than two (2) total routes

The zones were categorized as high, medium and low density based on an index calculated as:

Density = POP/2+REMP+OEMP
Where: POP is TAZ Population
REMP is TAZ Retail Employment
OEMP is TAZ Other Employment

The definitions for the classification levels are as follows:

High: Density > 10,000
Medium: Between High and Low
Low: Density < 5,000

The TAZs were classified as having a high, medium or low land use mix based on an index that reflects the variance between the shares of total residential, retail, and other commercial development. The formula for the land use mix index is as follows:

MUI = ((POP/2+REMP+OEMP)/3)/(Standard Deviation of POP/2, REMP, OEMP)

Where: MUI is Mixed Use Index
POP is TAZ Population
REMP is TAZ Retail Employment
OEMP is TAZ Other Employment

The definitions for the classification levels are as follows:

High: MUI >1.2
Medium: Between High and Low
Low: MUI <0.8

The relationships between the three land use characteristics and vehicle trip rates were developed using a cross-sectional analysis of year 2000 data for all of the PSRC model TAZs in King County. Table 2-8 was developed to provide an index of vehicle trip rates for differences between zones, with different classifications for each of the three land uses. A three-way table (6x3x3) was developed for commute trips by employees working in each zone.

TABLE 2-8 – Land Use Trip Rate Indices

Density	Transit Service	Mixed Use		
		High	Medium	Low
High	High-1	1.00	1.01	1.05
	High-2	1.02	1.04	1.08
	Medium-1	1.05	1.06	1.11
	Medium-2	1.06	1.07	1.12
	Low-1	1.08	1.09	1.15
	Low-2	1.08	1.09	1.15
Medium	High-1	1.01	1.02	1.07
	High-2	1.04	1.05	1.10
	Medium-1	1.06	1.08	1.13
	Medium-2	1.07	1.09	1.14
	Low-1	1.10	1.11	1.17
	Low-2	1.10	1.11	1.17
Low	High-1	1.07	1.08	1.13
	High-2	1.10	1.11	1.17
	Medium-1	1.13	1.14	1.20
	Medium-2	1.14	1.15	1.22
	Low-1	1.16	1.18	1.25
	Low-2	1.17	1.19	1.25

2.4.4. National Research

Local data were not available to assess the effectiveness of all the strategies included in this project. A thorough search of the national literature on TDM and land use effectiveness was used to find other evidence of strategy effectiveness. Much of this information was already available to the consultant team members because of the prior work done by the team members (Dagang and Loudon, 1992 and Loudon and Dagang, 1994). Other recent research that was reviewed includes:

- The Commuter Choice Benefits Calculator (Herzog and Grant, 2002)
- The COMMUTER Model (Herzog et al., 2001)
- Eco Software (Cambridge Systematics, 1999)

The results of the national research were used to supplement the local data where necessary and to provide a check on the results gained from the local data. Specifically, national data were used to derive price elasticities for transit, carpooling, and vanpooling.

2.5. Baseline Data

TEEM is designed to pivot off of baseline data for the study area where it is being applied. While the types of information that was collected for each study area is summarized in this section, the actual data for each case study area is presented in Appendix D. The baseline data for a study area includes:

- Information about existing and forecast year travel patterns
- Development characteristics without new TDM or land use strategies in place

Because the effectiveness of strategies is predicted as percentage changes in various travel characteristics, baseline data are necessary to know what the expected change would be. TEEM produces output in a summary form for each of the performance measures, but also as revisions of the baseline data. This latter form of output allows the analyst to more easily incorporate the results into subarea models or to do more detailed assessment of how study area travel patterns would change as a result of the tested strategies.

The sections below describe baseline data, and the source of that data, used in TEEM. Data are provided for 2000 and 2030. Most of the data come from area travel models. Some are derived from the PSRC/Trans-Lake Model, the regional model maintained by the PSRC as modified specifically for use in the SR 520 EIS. The PSRC/Trans-Lake model uses the same model structure and socioeconomic forecasts as the PSRC model used in the most recent Metropolitan Transportation Plan update, but the transportation network does not include all of the MTP improvements.

Data in TEEM are also derived from two local area models used by the jurisdictions involved in this project. These include a model maintained by the City of Seattle and the Bellevue-Kirkland-Redmond (BKR) model used by the three eastside jurisdictions. The BKR model was also used for the Redmond Ridge case study.

A case study report was prepared for each of the ten case study areas identified in this report. The case study reports provide a summary of the data identified in this section and the reports follow the same outline.

2.5.1. Population and Employment Case Study Areas

Population data are provided for each local TAZ for each of the two analysis years (2000 and 2030) The population data are based on the PSRC forecast data but are allocated to local TAZs by the number of dwelling units, which is available in the local models.

Employment data are also provided at the local TAZ level in two categories: retail employment and all other employment. The data are taken directly from the local models, which are consistent with the PSRC forecasts for employment but provides more data on the specific location of land uses than the PSRC forecast database.

2.5.2. Employment by Size of Employer

The employment in each study area is also categorized by size of employer for 2000. This information was provided by PSRC but is derived from Washington Employment Security Department (ESD) data. Four categories of employer size are used:

- 1 to 50
- 51 to 100
- 101 to 500
- Over 500

The distribution of employment by size of employer is assumed to remain the same for future years. No forecasts of distribution by size of employer are available.

In many parts of the TEEM, employment is also characterized as CTR or non-CTR. This is based on the actual number of CTR employers and the people employed as represented by the 2001 CTR database.

The type of employer is differentiated only as retail or non-retail. This information is derived from the local models, the ESD data and the CTR database (for CTR employers).

2.5.3. Transit Service and Ridership

Transit service in and through each case study area was described using information from the PSRC/Trans-Lake regional model. The model information was used to categorize each local TAZ into one of six categories as previously indicated: High-1, High-2, Medium-1, Medium 2, Low-1 or Low-2. The definitions of the six grades are listed in Table 2-7. These categories were defined by noting clear breakpoints in year 2000 transit service quality.

The transit network prepared for the SR 520 EIS is based on transit service hours proposed by King County Metro (i.e., what is in their 6-year plan + 1% increase/year.) Five Bus Rapid Transit (BRT) alignments were developed with 10-minute headways. The BRT routes serve the following origin-destination pairs:

- Totem Lake to the University District
- Totem Lake to the Seattle CBD

- Redmond/Willows Road to the University District
- Redmond/Willows Road to the Seattle CBD
- Bellevue CBD to the University District

The BRT routes are in addition to local King County Metro service, but would replace certain existing regional bus service.

2.5.4. Baseline TDM and Land Use Strategy Applications

The primary source of information on what is already being implemented in each study area is the CTR database. Supplemental information is also available from Traffic Mitigation Program reports (primarily in Redmond) and from King County Metro (FlexPass and Vanpool program participation). Some information on land use strategies is also available from research conducted locally by Anne Moudon, Larry Frank and Scott Rutherford.

The only assumption coded into PSRC's regional modeling process to represent TDM strategies was parking costs. Table 2-9 shows the parking costs assumed for the years 2000 and 2030. The costs shown are an hourly charge for commute trips to the case study area for non-carpool and carpool parking. All costs are in year 2000 dollars and are used in the PSRC/Trans-Lake 2030 model runs. All TEEM forecasts of a parking pricing strategy are for pricing increases *over* the levels reported in Table 2-9.

TABLE 2-9 – Current and Future Parking Costs

	Parking Costs					
	2000 Base Drive Alone	2030 Base Drive Alone	2001 Base Carpool	2030 Base Carpool	2001 Base Vanpool	2030 Base Vanpool
1. University District	$ 3.79	$ 9.21	$ 1.52	$ 3.68	$ -	$ -
2. South Lake Union	$ 1.44	$ 3.48	$ 1.31	$ 3.17	$ -	$ -
3. Wallingford	$ 1.66	$ 4.03	$ 1.20	$ 2.90	$ -	$ -
4. Downtown Redmond	$ -	$ 2.25	$ -	$ 0.33	$ -	$ -
5. Willows	$ -	$ 1.12	$ -	$ 0.67	$ -	$ -
6. Downtown Kirkland	$ -	$ -	$ -	$ -	$ -	$ -
7. Totem Lake	$ -	$ 1.34	$ -	$ 0.67	$ -	$ -
8. Downtown Bellevue	$ 3.76	$ 9.11	$ 1.80	$ 4.34	$ -	$ -
9. Crossroads	$ -	$ 0.67	$ -	$ 0.33	$ -	$ -
10. Redmond Ridge	$ -	$ -	$ -	$ -	$ -	$ -

2.5.5. Work Trips and Mode Shares

Data on work trips and mode shares was provided for each local TAZ and was taken almost directly from the local models. Supplemental data were also available from the 1990 Census Journey to Work Survey, the CTR Database, and a commute mode survey conducted by the City of Bellevue for Downtown Bellevue and Crossroads.

2.5.6. Non-Work Trips and Mode Shares

Data on non-work trips and mode shares were also provided for each local TAZ and were taken directly from the local models.

2.5.7. Time of Travel by Trip Type

A distribution of trip starts and ends by trip purpose was used in TEEM to determine whether changes in travel affect the A.M. or P.M. peak periods. The distribution used in the methodology was derived from PSRC survey data.

2.5.8. Trip-Length Distribution

A profile of work trip length distribution was provided for each study area based on data from the local travel model. Work trip length was used in determining the attractiveness of strategies designed to encourage certain modes such as vanpooling, bicycling and walking.

2.5.9. Origin-Destination Patterns for Auto Trips on SR 520 (at bridge midpoint)

The PSRC model was used to determine the origins and destination of person trips crossing the mid-point of the SR 520 Bridge. This information was used to determine the proportion of trips to and from a study area that use the bridge on a daily basis and in the A.M. and P.M. peak hours. This proportion was used to determine how a reduction in vehicle trips to or from a study area would affect the SR 520 Bridge.

3. Results and Recommendations

3.1. Results

The following section details the results of the fifty strategy applications (five strategies in each of the ten case study areas) in TEEM. Table 3.1 summarized the strategies tested in each of the case study areas and the levels at which they were tested. All of the results reported in the following section are for 2030 and are for commute travel only.

The results of the TEEM application for the ten case study areas are presented in Tables 3-2 through 3-5, and show the incremental change in year 2030 travel using the five performance measures. The tables provide a 2030 "Base" level for the performance measure being reported, the "Change" that is expected from the strategies tested and a "Percent Change" from the base. The "Change" reported for Commute Mode Share is the percentage-point change in drive alone mode share.[1]

The evaluation of strategies for the ten case study areas indicated that with a reasonable level of implementation for five strategies in each case study area, the reduction in daily commute vehicle trips by study area employees could be, on average, about 5 percent. As indicated in Figure 3-1, the percentage change varies slightly depending on the performance measure used. Because only five strategies were tested in each case study area, it is quite possible that a different set of strategies, or more of them, could prove more effective in reducing vehicle trips for each for each of the case study areas.

Tables 3-2 through Table 3-5 indicate that the effects of the strategy packages tested would vary between case study areas. Using "Daily Commute Vehicle Trips" as the measure, the effectiveness of the strategies tested would range from a low of 0.9% reduction in Crossroads to 11.4% in Downtown Kirkland (see Table 3-3). Although the percentages vary slightly for different performance measures, the results are similar. As indicated in Figure 3-2, the highest percentage reductions are in Downtown Kirkland (11.3%), Totem Lake (7.9%), Downtown Redmond (6.5%), Redmond Ridge (6.4%) and South Lake Union (5.3%). The largest number of daily commute trips reduced, however, came from Downtown Bellevue (2698 trips) where the percentage reduction was below average but the base number of commute trips was more than twice any other case study area. The University District, with the second highest study area employment in 2030, had the fourth highest total reduction in daily commute trips (1252 trips).

The testing of individual strategies also revealed a significant difference in effectiveness. *Parking Pricing at Employment Sites* produced the highest percentage reductions in daily commute trips, ranging from 1.6% in Downtown Bellevue (where the baseline parking price was assumed to be high) in 2030 to 9.8% in Downtown Kirkland (where the baseline price in

[1] A percentage-point change results from a change in a characteristic that is reported in percentages. For example, a change from 60 percent drive alone mode share to 55 percent drive alone results in a 5 percentage point chance in mode share. A percent change, on the other hand, is the percent change for the measure from the original value. For example, if vehicle trips change from 1000 to 750 trips, then there is a 25 percent change in vehicle trips.

2030 was assumed to be very low). However, even though the percentage reduction from this strategy was lower in Downtown Bellevue than anywhere else it was tested, the total reduction in daily commute trips (1360 trips) was the second largest reduction from parking pricing and the second largest reduction from any single strategy. Only parking pricing in Totem Lake produced a larger reduction (1430 trips). The three case study areas with the lowest total reductions in commute trips, Willows Road (251 trips), Wallingford (216 trips), and Crossroads (75 trips), did not have parking pricing among the strategies tested. The analysis of parking price indicates that any type of strategy that affects the pricing of automobile use can have a significant affect on commute trip demand. Pricing of auto use is likely to be most effective where there are alternative modes available.

The second most effective strategy for daily commute trip reduction at the levels tested was *Increased Infill and Densification.* The strategy produced a reduction of 1170 trips in South Lake Union. Another land use measure, *Increased Mixed-Use Development*, produced the third highest reduction with 1039 trips in Downtown Bellevue. Other strategies that produced significant reductions were *Alternative Mode Subsidy* (806 trips in Downtown Bellevue) *Multi-Employer TMA* (330 trips in Totem Lake), *Improved Bicycle Access* (246 trips in the University District), and *CTR-type Program for Smaller Employers* (261 trips in Totem Lake). The remaining strategies produced daily commute trip reductions of less than 200 trips in the case study areas where they were tested.

In general, it appears from the testing of strategies that the most effective approach will be a combination of strategies that provide:

- Pricing
- Transit & Nonmotorized Supportive Land Use
- Promotion/Coordination
- Alternative Mode Options
- Such a combination of strategies will work together supportively.

The combined effect of the strategy tests for the ten case study areas on the SR 520 Bridge is to reduce the total PM peak period vehicular traffic by about 2.5% eastbound 5.2% westbound (about 0.2% of all trips on the bridge). This is a seemingly small effect; however, all of the PM peak period commute trips to and from the case study areas represent only about 7 % of the eastbound bridge traffic in the PM peak period and only about 4% of the westbound traffic. The case study areas, obviously, comprise only a small portion of the population and employment that produce commute trips in the corridor. Furthermore, even though the bridge has been shown to have higher-than-average levels of peak hour commute trips, there are also non-commute trips crossing the lake at peak times.

Because the forecasts are for 2030, some of the strategies that may ultimately produce significant reductions may take many years for the strategies to be fully implemented and for the strategies to take effect. This is particularly true of the land use strategies, which can only be implemented incrementally over time as growth occurs. Others, such as *Parking Pricing at Employment Sites* may take time for implementation because of political resistance and institutional opposition. In contrast, many of the employer-based programs that have been the

staple of the CTR program can be implemented rather quickly, but may require a more concerted effort to maintain and fund them over time.

A summary of the results for the individual case study areas is provided below.

Seattle

University District – The strategies tested produced significant trip reductions among the study area employees. Parking Pricing at Employment Sites, Alternative Mode Subsidy and Improved Bicycle Access produced the most significant reductions. Because of the large residential population and the excellent transit service, Residential Flexpass Program might also be considered.

South Lake Union – All of the strategies tested produced significant improvement, but Increased Infill and Densification and Increased Mixed Use Development produced the greatest change. Parking Pricing at Employment Sites is also likely to produce significant reductions and should be tested. Because of the large residential population in close proximity, Improved Bicycle Access might also produce a significant reduction for employees and residents of the area.

Wallingford – The five strategies tested produced only modest results for Wallingford, with the greatest reductions coming from Multi-Employer TMA and Flexpass/Residential Pass. Consideration should also be given to Parking Pricing at Employment Sites because it produced large reductions in all areas where it was tested.

Redmond

Downtown – Parking Pricing at Employment Sites produced the most significant results, although Increased Mixed Use Development also produced modest results. Alternative Mode Subsidy might be tested to reduce commute trips into the area and Improved Bicycle Access might be tested to reduce trips by residents and study area employees. Both of these were found to be reasonably effective in the Willows Road study area.

Willows Road – Alternative Mode Subsidy and Improved Bicycle Access showed the greatest promise of the strategies tested, although the expected change was not large. Parking Pricing at Employment Sites was not tested in this area and would most likely produce significant results.

Kirkland

Downtown – Parking Pricing at Employment Sites produced by far the greatest change. The results from the other strategies were modest. Consideration might be given to testing Alternative Mode Subsidy, Multi-Employer TMA and CTR-Type Program for Small Employers, which had encouraging results in other eastside employment centers.

Totem Lake – Parking Pricing at Employment Sites produced the greatest change, although Multi-Employer TMA and CTR-Type Programs for Small Employers produced encouraging results. Other strategies that might produce reductions in the area are the three land use strategies and improvement of bicycle and pedestrian access.

Bellevue

Downtown – Parking Pricing at Employment Sites, Increased Mixed Use Development and Alternative Mode Subsidy all produced significant reductions and complement an already active employer-based program and high levels of alternative mode use by employees. Other strategies that might be tested include those that target the large number of residents. These include Improved Bicycle Access and a Flexpass/Residential Pass program.

Crossroads – The strategies tested demonstrated on modest results. Parking Pricing at Employment Sites should be considered as well as Improved Bicycle Access, which have demonstrated effectiveness in other eastside mixed-use areas.

King County

Redmond Ridge – All of the strategies tested demonstrated reasonable effectiveness for study area employees and residents. Parking Pricing at Employment Sites might also be tested for corridor consistency and Improved Pedestrian Access might be tested to get more reduction from study area residents working in the development.

3.2. Validation of Results

The accuracy and validity of TEEM's forecasts, and of TDM's effectiveness in general, are difficult to specify. The reported experiences from which forecast tools like TEEM are derived demonstrate a wide range of effectiveness. In developing TEEM, the project team drew heavily from the reported experiences in the CTR database for King County. For 267 companies that had adequate reporting data to determine the effect of their CTR program, the mean reduction in drive alone share was 3.5%. However, the individual rates of effectiveness vary widely.

A similar disparity is also found in individual TDM strategies. A review of national experience with TDM and land use strategies revealed a broad range in the rates of strategy effectiveness in almost all categories. As one example, WSDOT's Vanpool Market Study[2] found much higher potential for vanpooling in the Puget Sound Region than the rates of effectiveness predicted by TEEM. These discrepancies are mainly due to the nature of the data in that the Vanpool Market Study bases its data on market projection surveys, while TEEM bases its forecasts on reported experiences.

With such broad range in the reported experiences, it is difficult to quantify the accuracy of a TDM forecasting tool. To emphasize that there is disparity in the reported experiences, and to avoid the fallacy of false precision, the TEEM has been programmed to provide ranges of effectiveness as a percentage of the mean value. A default value of 50% has been coded into TEEM, which can be changed by the user. Although there is more variation in individual values than in a single area-wide estimate, a range of +/- 50% reasonably estimates the range found multiple area-wide mean values - if multiple estimates were available. Unfortunately, for most strategies, there are reported experiences for only a few programs at best.

[2] Washington DOT, Vanpool Market Study, October 2000

TABLE 3-1 – Strategy Levels Tested by Case Study Area

Strategy	Test Level
1. University District	
1 Alternative Mode Subsidy	$2/day for 20% of employees
2 CTR-type Program for Small Employers	Apply program
3 Increased Density Near Transit Corridors	Redistributed 50% growth to top 20% of zones
4 Bicycle Access	Increase coverage 20%
5 Parking Pricing at Employment Sites	$2/day increase
2. South Lake Union	
1 Alternative Mode Subsidy	$2/day for 20% of employees
2 Multi-Employer TMA	Apply program
3 Encourage Mixed-Use Development	Redistributed 50% growth to top 20% of zones
4 Encourage Infill & Densification	Redistributed 50% growth to top 20% of zones
5 Flexpass/Residential Pass	Offer to 20% of employees
3. Wallingford	
1 Alternative Mode Subsidy	$2/day for 20% of employees
2 CTR-type Program for Small Employers	Apply program
3 Multi-Employer TMA	Apply program
4 Bicycle Access	Increase coverage 20%
5 Flexpass/Residential Pass	Offer to 20% of employees
4. Downtown Redmond	
1 Vanpool Program	Additional 20% of employees
2 Encourage Mixed-Use Development	Redistributed 50% growth to top 20% of zones
3 Pedestrian Access	Increase coverage 10%
4 Restricted Parking Supply	Reduce parking ratio 20%
5 Parking Pricing at Employment Sites	$3/day increase
5. Willows	
1 Vanpool Program	Additional 20% of employees
2 Alternative Mode Subsidy	$2/day for 20% of employees
3 Telecommuting	Additional 20% of employees
4 Increased Density Near Transit Corridors	Redistributed 50% growth to high transit zones
5 Bicycle Access	Increase coverage 20%
6. Downtown Kirkland	
1 Telecommuting	Additional 20% of employees
2 Multi-Employer TMA	Apply program
3 Restricted Parking Supply	Reduce parking ratio 20%
4 Parking Pricing at Employment Sites	$3/day increase
5 Flexpass/Residential Pass	Offer to 20% of employees
7. Totem Lake	
1 Vanpool Program	Additional 20% of employees
2 CTR-type Program for Small Employers	Apply program
3 Multi-Employer TMA	Apply program
4 Parking Pricing at Employment Sites	$3/day increase
5 Flexpass/Residential Pass	Offer to 20% of employees
8. Downtown Bellevue	
1 Alternative Mode Subsidy	$2/day for 20% of employees
2 Increased Density Near Transit Corridors	Redistributed 50% growth to high transit zones
3 Encourage Mixed-Use Development	Redistributed 50% growth to top 20% of zones
4 Encourage Infill & Densification	Redistributed 50% growth to top 20% of zones
5 Parking Pricing at Employment Sites	$2/day increase
9. Crossroads	
1 Alternative Mode Subsidy	$2/day for 20% of employees
2 Increased Density Near Transit Corridors	Redistributed 50% growth to high transit zones
3 Encourage Mixed-Use Development	Redistributed 50% growth to top 20% of zones
4 Encourage Infill & Densification	Redistributed 50% growth to top 20% of zones
5 Flexpass/Residential Pass	Offer to 20% of employees
10. Redmond Ridge	
1 Vanpool Program	Additional 20% of employees
2 Alternative Mode Subsidy	$2/day for 20% of employees
3 Compressed Work Week	Additional 50% of employees
4 Bicycle Access	Increase coverage 40%
5 Flexpass/Residential Pass	Offer to 20% of employees

TABLE 3-2 – Results of TEEM Applications: Change in Commute Drive Alone Mode Share

			Employees			Residents		
			Base	Pct. Pt. Change	Percent Change	Base	Pct. Pt. Change	Percent Change
University District			47.5%			39.0%		
	1.1	Alternative Mode Subsidy		-1.1%	-2.3%		0.0%	0.0%
	1.2	CTR-type Program for Small Employers		-0.1%	-0.3%		0.0%	0.0%
	1.3	Increased Density Near Transit Corridors		0.0%	0.0%		0.0%	0.0%
	1.4	Bicycle Access		-0.3%	-0.5%		-0.5%	-1.3%
	1.5	Parking Pricing at Employment Sites		-1.2%	-2.6%		0.0%	0.0%
		Combined:		**-2.7%**	**-5.6%**		**-0.5%**	**-1.3%**
South Lake Union			52.8%			40.5%		
	2.1	Alternative Mode Subsidy		-0.9%	-1.7%		0.0%	0.0%
	2.2	Multi-Employer TMA		-1.0%	-1.8%		0.0%	0.0%
	2.3	Encourage Mixed-Use Development		-2.3%	-4.3%		0.0%	0.0%
	2.4	Encourage Infill & Densification		-3.5%	-6.6%		0.0%	0.0%
	2.5	Flexpass/Residential Pass		0.0%	0.0%		-1.4%	-3.4%
		Combined:		**-4.3%**	**-8.1%**		**-1.4%**	**-3.4%**
Wallingford			58.5%			36.5%		
	3.1	Alternative Mode Subsidy		-0.8%	-1.4%		0.0%	0.0%
	3.2	CTR-type Program for Small Employers		-0.8%	-1.4%		0.0%	0.0%
	3.3	Multi-Employer TMA		-1.6%	-2.7%		0.0%	0.0%
	3.4	Bicycle Access		-0.2%	-0.3%		-0.5%	-1.3%
	3.5	Flexpass/Residential Pass		0.0%	0.0%		-1.4%	-3.7%
		Combined:		**-3.4%**	**-5.8%**		**-1.8%**	**-5.1%**
Downtown Redmond			54.5%			59.4%		
	4.1	Vanpool Program		-0.1%	-0.3%		0.0%	0.0%
	4.2	Encourage Mixed-Use Development		-1.9%	-3.5%		0.0%	0.0%
	4.3	Pedestrian Access		-0.2%	-0.4%		-0.5%	-0.8%
	4.4	Restricted Parking Supply		0.0%	-0.1%		0.0%	0.0%
	4.5	Parking Pricing at Employment Sites		-4.4%	-8.1%		0.0%	0.0%
		Combined:		**-6.5%**	**-12.0%**		**-0.5%**	**-0.8%**
Willows Road			70.7%			61.1%		
	5.1	Vanpool Program		-0.3%	-0.5%		0.0%	0.0%
	5.2	Alternative Mode Subsidy		-0.7%	-1.1%		0.0%	0.0%
	5.3	Telecommuting		0.0%	0.0%		0.0%	0.0%
	5.4	Increased Density Near Transit Corridors		0.4%	0.6%		0.0%	0.0%
	5.5	Bicycle Access		-0.1%	-0.2%		-0.5%	-0.8%
		Combined:		**-0.8%**	**-1.1%**		**-0.5%**	**-0.8%**

TABLE 3-2 (Continued)– Results of TEEM Applications: Change in Commute Drive Alone Mode Share

			Employees			Residents		
			Base	Pct. Pt. Change	Percent Change	Base	Pct. Pt. Change	Percent Change
Downtown Kirkland			67.3%			50.8%		
	6.1	Telecommuting		0.0%	0.0%		0.0%	0.0%
	6.2	Multi-Employer TMA		-1.8%	-2.7%		0.0%	0.0%
	6.3	Restricted Parking Supply		0.0%	0.0%		0.0%	0.0%
	6.4	Parking Pricing at Employment Sites		-12.2%	-18.2%		0.0%	0.0%
	6.5	Flexpass/Residential Pass		-0.1%	-0.1%		0.0%	0.0%
		Combined:		**-13.8%**	**-20.5%**		**0.0%**	**0.0%**
Totem Lake			63.7%			57.2%		
	7.1	Vanpool Program		-0.2%	-0.3%		0.0%	0.0%
	7.2	CTR-type Program for Small Employers		-0.8%	-1.2%		0.0%	0.0%
	7.3	Multi-Employer TMA		-1.5%	-2.4%		0.0%	0.0%
	7.4	Parking Pricing at Employment Sites		-6.5%	-10.1%		0.0%	0.0%
	7.5	Flexpass/Residential Pass		-0.1%	-0.1%		0.0%	0.0%
		Combined:		**-8.7%**	**-13.7%**		**0.0%**	**0.0%**
Downtown Bellevue			56.6%			56.6%		
	8.1	Alternative Mode Subsidy		-0.8%	-1.4%		0.0%	0.0%
	8.2	Increased Density Near Transit Corridors		0.0%	0.0%		0.0%	0.0%
	8.3	Encourage Mixed-Use Development		-1.1%	-1.9%		0.0%	0.0%
	8.4	Encourage Infill & Densification		0.0%	0.0%		0.0%	0.0%
	8.5	Parking Pricing at Employment Sites		-1.4%	-2.5%		0.0%	0.0%
		Combined:		**-2.8%**	**-4.9%**		**0.0%**	**0.0%**
Crossroads			69.8%			55.7%		
	9.1	Alternative Mode Subsidy		-0.7%	-1.0%		0.0%	0.0%
	9.2	Increased Density Near Transit Corridors		-0.1%	-0.2%		0.0%	0.0%
	9.3	Encourage Mixed-Use Development		-0.5%	-0.7%		0.0%	0.0%
	9.4	Encourage Infill & Densification		-0.9%	-1.2%		0.0%	0.0%
	9.5	Flexpass/Residential Pass		0.0%	0.0%		-0.5%	-0.8%
		Combined:		**-1.1%**	**-1.5%**		**-0.5%**	**-0.8%**
Redmond Ridge			72.3%			62.2%		
	10.1	Vanpool Program		-1.6%	-2.2%		0.0%	0.0%
	10.2	Alternative Mode Subsidy		-1.6%	-2.2%		0.0%	0.0%
	10.3	Compressed Work Week		0.0%	0.0%		0.0%	0.0%
	10.4	Bicycle Access		-0.3%	-0.4%		-1.0%	-1.6%
	10.5	Flexpass/Residential Pass		0.0%	0.0%		-0.2%	-0.4%
		Combined:		**-3.6%**	**-5.0%**		**-1.2%**	**-1.9%**

TABLE 3-3 – Results of TEEM Applications: Change in Daily Commute Vehicle Trips

			Employees			Residents		
			Base	Change	Percent Change	Base	Change	Percent Change
University District			28,186			3,080		
	1.1	Alternative Mode Subsidy		-448	-1.6%		0	0.0%
	1.2	CTR-type Program for Small Employers		-54	-0.2%		0	0.0%
	1.3	Increased Density Near Transit Corridors		0	0.0%		0	0.0%
	1.4	Bicycle Access		-246	-0.9%		-34	-1.1%
	1.5	Parking Pricing at Employment Sites		-523	-1.9%		0	0.0%
		Combined:		**-1,252**	**-4.4%**		**-34**	**-1.1%**
South Lake Union			24,648			6,075		
	2.1	Alternative Mode Subsidy		-272	-1.1%		0	0.0%
	2.2	Multi-Employer TMA		-291	-1.2%		0	0.0%
	2.3	Encourage Mixed-Use Development		-701	-2.8%		0	0.0%
	2.4	Encourage Infill & Densification		-1,079	-4.4%		0	0.0%
	2.5	Flexpass/Residential Pass		0	0.0%		-195	-3.2%
		Combined:		**-1,307**	**-5.3%**		**-195**	**-3.2%**
Wallingford			4,386			2,327		
	3.1	Alternative Mode Subsidy		-42	-1.0%		0	0.0%
	3.2	CTR-type Program for Small Employers		-62	-1.4%		0	0.0%
	3.3	Multi-Employer TMA		-81	-1.8%		0	0.0%
	3.4	Bicycle Access		-32	-0.7%		-27	-1.1%
	3.5	Flexpass/Residential Pass		0	0.0%		-80	-3.5%
		Combined:		**-216**	**-4.9%**		**-107**	**-4.6%**
Downtown Redmond			15,116			3,890		
	4.1	Vanpool Program		-33	-0.2%		0	0.0%
	4.2	Encourage Mixed-Use Development		-259	-1.7%		0	0.0%
	4.3	Pedestrian Access		-107	-0.7%		-28	-0.7%
	4.4	Restricted Parking Supply		-4	0.0%		0	0.0%
	4.5	Parking Pricing at Employment Sites		-600	-4.0%		0	0.0%
		Combined:		**-976**	**-6.5%**		**-28**	**-0.7%**
Willows Road			17,721			1,816		
	5.1	Vanpool Program		-71	-0.4%		0	0.0%
	5.2	Alternative Mode Subsidy		-99	-0.6%		0	0.0%
	5.3	Telecommuting		-31	-0.2%		0	0.0%
	5.4	Increased Density Near Transit Corridors		57	0.3%		0	0.0%
	5.5	Bicycle Access		-106	-0.6%		-12	-0.7%
		Combined:		**-251**	**-1.4%**		**-12**	**-0.7%**

TABLE 3-3 (Continued) – Results of TEEM Applications: Change in Daily Commute Vehicle Trips

			Employees			Residents		
			Base	Change	Percent Change	Base	Change	Percent Change
Downtown Kirkland			6,718			4,239		
	6.1	Telecommuting		-12	-0.2%		0	0.0%
	6.2	Multi-Employer TMA		-97	-1.4%		0	0.0%
	6.3	Restricted Parking Supply		0	0.0%		0	0.0%
	6.4	Parking Pricing at Employment Sites		-658	-9.8%		0	0.0%
	6.5	Flexpass/Residential Pass		-9	-0.1%		0	0.0%
		Combined:		**-759**	**-11.3%**		**0**	**0.0%**
Totem Lake			26,699			5,318		
	7.1	Vanpool Program		-73	-0.3%		0	0.0%
	7.2	CTR-type Program for Small Employers		-261	-1.0%		0	0.0%
	7.3	Multi-Employer TMA		-330	-1.2%		0	0.0%
	7.4	Parking Pricing at Employment Sites		-1,430	-5.4%		0	0.0%
	7.5	Flexpass/Residential Pass		-26	-0.1%		0	0.0%
		Combined:		**-2,096**	**-7.9%**		**0**	**0.0%**
Downtown Bellevue			83,706			22,214		
	8.1	Alternative Mode Subsidy		-806	-1.0%		0	0.0%
	8.2	Increased Density Near Transit Corridors		-27	0.0%		0	0.0%
	8.3	Encourage Mixed-Use Development		-1,039	-1.2%		0	0.0%
	8.4	Encourage Infill & Densification		2	0.0%		0	0.0%
	8.5	Parking Pricing at Employment Sites		-1,360	-1.6%		0	0.0%
		Combined:		**-2,698**	**-3.2%**		**0**	**0.0%**
Crossroads			8,090			6,723		
	9.1	Alternative Mode Subsidy		-49	-0.6%		0	0.0%
	9.2	Increased Density Near Transit Corridors		-10	-0.1%		0	0.0%
	9.3	Encourage Mixed-Use Development		-34	-0.4%		0	0.0%
	9.4	Encourage Infill & Densification		-60	-0.7%		0	0.0%
	9.5	Flexpass/Residential Pass		0	0.0%		-53	-0.8%
		Combined:		**-75**	**-0.9%**		**-53**	**-0.8%**
Redmond Ridge			5,277			15,528		
	10.1	Vanpool Program		-102	-1.9%		0	0.0%
	10.2	Alternative Mode Subsidy		-61	-1.2%		0	0.0%
	10.3	Compressed Work Week		-108	-2.0%		0	0.0%
	10.4	Bicycle Access		-62	-1.2%		-205	-1.3%
	10.5	Flexpass/Residential Pass		0	0.0%		-54	-0.3%
		Combined:		**-336**	**-6.4%**		**-259**	**-1.7%**
Total All Case Study Areas			**220,548**	**-9,965**	**-4.5%**	**71,212**	**-688**	**-1.0%**

TABLE 3-4 – Results of TEEM Applications: Change in Daily Commute VMT

			Employees			Residents		
			Base	Change	Percent Change	Base	Change	Percent Change
University District			323,521			34,259		
	1.1	Alternative Mode Subsidy		-4,290	-1.3%		0	0.0%
	1.2	CTR-type Program for Small Employers		-521	-0.2%		0	0.0%
	1.3	Increased Density Near Transit Corridors		0	0.0%		0	0.0%
	1.4	Bicycle Access		-2,621	-0.8%		-368	-1.1%
	1.5	Parking Pricing at Employment Sites		-5,046	-1.6%		0	0.0%
		Combined:		**-12,287**	**-3.8%**		**-368**	**-1.1%**
South Lake Union			348,802			85,030		
	2.1	Alternative Mode Subsidy		-3,437	-1.0%		0	0.0%
	2.2	Multi-Employer TMA		-3,651	-1.0%		0	0.0%
	2.3	Encourage Mixed-Use Development		-8,882	-2.5%		0	0.0%
	2.4	Encourage Infill & Densification		-13,676	-3.9%		0	0.0%
	2.5	Flexpass/Residential Pass		0	0.0%		-2,724	-3.2%
		Combined:		**-16,510**	**-4.7%**		**-2,724**	**-3.2%**
Wallingford			55,603			29,493		
	3.1	Alternative Mode Subsidy		-462	-0.8%		0	0.0%
	3.2	CTR-type Program for Small Employers		-800	-1.4%		0	0.0%
	3.3	Multi-Employer TMA		-881	-1.6%		0	0.0%
	3.4	Bicycle Access		-389	-0.7%		-322	-1.1%
	3.5	Flexpass/Residential Pass		0	0.0%		-1,018	-3.5%
		Combined:		**-2,529**	**-4.5%**		**-1,338**	**-4.5%**
Downtown Redmond			255,008			64,346		
	4.1	Vanpool Program		-555	-0.2%		0	0.0%
	4.2	Encourage Mixed-Use Development		-3,725	-1.5%		0	0.0%
	4.3	Pedestrian Access		-1,729	-0.7%		-460	-0.7%
	4.4	Restricted Parking Supply		-56	0.0%		0	0.0%
	4.5	Parking Pricing at Employment Sites		-8,634	-3.4%		0	0.0%
		Combined:		**-14,327**	**-5.6%**		**-460**	**-0.7%**
Willows Road			270,087			27,741		
	5.1	Vanpool Program		-982	-0.4%		0	0.0%
	5.2	Alternative Mode Subsidy		-1,116	-0.4%		0	0.0%
	5.3	Telecommuting		-472	-0.2%		0	0.0%
	5.4	Increased Density Near Transit Corridors		654	0.2%		0	0.0%
	5.5	Bicycle Access		-1,545	-0.6%		-181	-0.7%
		Combined:		**-3,474**	**-1.3%**		**-181**	**-0.7%**

TABLE 3-4 (Continued) – Results of TEEM Applications: Change in Daily Commute VMT

			Employees			Residents		
			Base	Change	Percent Change	Base	Change	Percent Change
Downtown Kirkland			84,157			53,260		
	6.1	Telecommuting		-147	-0.2%		0	0.0%
	6.2	Multi-Employer TMA		-979	-1.2%		0	0.0%
	6.3	Restricted Parking Supply		0	0.0%		0	0.0%
	6.4	Parking Pricing at Employment Sites		-6,696	-8.0%		0	0.0%
	6.5	Flexpass/Residential Pass		-111	-0.1%		0	0.0%
		Combined:		**-7,769**	**-9.2%**		**0**	**0.0%**
Totem Lake			428,321			84,691		
	7.1	Vanpool Program		-1,155	-0.3%		0	0.0%
	7.2	CTR-type Program for Small Employers		-3,933	-0.9%		0	0.0%
	7.3	Multi-Employer TMA		-3,855	-0.9%		0	0.0%
	7.4	Parking Pricing at Employment Sites		-17,007	-4.0%		0	0.0%
	7.5	Flexpass/Residential Pass		-426	-0.1%		0	0.0%
		Combined:		**-26,405**	**-6.2%**		**0**	**0.0%**
Downtown Bellevue			1,264,911			334,828		
	8.1	Alternative Mode Subsidy		-11,080	-0.9%		0	0.0%
	8.2	Increased Density Near Transit Corridors		-369	0.0%		0	0.0%
	8.3	Encourage Mixed-Use Development		-14,145	-1.1%		0	0.0%
	8.4	Encourage Infill & Densification		21	0.0%		0	0.0%
	8.5	Parking Pricing at Employment Sites		-18,512	-1.5%		0	0.0%
		Combined:		**-36,830**	**-2.9%**		**0**	**0.0%**
Crossroads			125,716			106,124		
	9.1	Alternative Mode Subsidy		-510	-0.4%		0	0.0%
	9.2	Increased Density Near Transit Corridors		-107	-0.1%		0	0.0%
	9.3	Encourage Mixed-Use Development		-367	-0.3%		0	0.0%
	9.4	Encourage Infill & Densification		-647	-0.5%		0	0.0%
	9.5	Flexpass/Residential Pass		0	0.0%		-832	-0.8%
		Combined:		**-790**	**-0.6%**		**-832**	**-0.8%**
Redmond Ridge			80,305			238,853		
	10.1	Vanpool Program		-1,403	-1.7%		0	0.0%
	10.2	Alternative Mode Subsidy		-685	-0.9%		0	0.0%
	10.3	Compressed Work Week		-1,645	-2.0%		0	0.0%
	10.4	Bicycle Access		-905	-1.1%		-2,979	-1.2%
	10.5	Flexpass/Residential Pass		0	0.0%		-828	-0.3%
		Combined:		**-4,676**	**-5.8%**		**-3,806**	**-1.6%**
Total All Case Study Areas			**3,236,432**	**-125,597**	**-3.9%**	**1,058,626**	**-9,708**	**-0.9%**

TABLE 3-5 – Results of TEEM Applications: Change in PM Peak Period Commute Trips

			From the Study Area			To the Study Area		
			Base	Change	Percent Change	Base	Change	Percent Change
University District			7,747			1,320		
	1.1	Alternative Mode Subsidy		-122	-1.6%		-8	-0.6%
	1.2	CTR-type Program for Small Employers		-15	-0.2%		-1	-0.1%
	1.3	Increased Density Near Transit Corridors		0	0.0%		0	0.0%
	1.4	Bicycle Access		-68	-0.9%		-14	-1.0%
	1.5	Parking Pricing at Employment Sites		-143	-1.8%		-9	-0.7%
		Combined:		**-342**	**-4.4%**		**-31**	**-2.3%**
South Lake Union			6,832			2,077		
	2.1	Alternative Mode Subsidy		-74	-1.1%		-5	-0.2%
	2.2	Multi-Employer TMA		-79	-1.2%		-5	-0.2%
	2.3	Encourage Mixed-Use Development		-191	-2.8%		-12	-0.6%
	2.4	Encourage Infill & Densification		-295	-4.3%		-18	-0.9%
	2.5	Flexpass/Residential Pass		-3	0.0%		-53	-2.6%
		Combined:		**-360**	**-5.3%**		**-75**	**-3.6%**
Wallingford			1,237			710		
	3.1	Alternative Mode Subsidy		-12	-0.9%		-1	-0.1%
	3.2	CTR-type Program for Small Employers		-17	-1.4%		-1	-0.1%
	3.3	Multi-Employer TMA		-22	-1.8%		-1	-0.2%
	3.4	Bicycle Access		-9	-0.7%		-8	-1.1%
	3.5	Flexpass/Residential Pass		-1	-0.1%		-22	-3.1%
		Combined:		**-61**	**-4.9%**		**-33**	**-4.6%**
Downtown Redmond			4,193			1,319		
	4.1	Vanpool Program		-9	-0.2%		-1	0.0%
	4.2	Encourage Mixed-Use Development		-71	-1.7%		-4	-0.3%
	4.3	Pedestrian Access		-30	-0.7%		-10	-0.7%
	4.4	Restricted Parking Supply		-1	0.0%		0	0.0%
	4.5	Parking Pricing at Employment Sites		-164	-3.9%		-10	-0.8%
		Combined:		**-267**	**-6.4%**		**-24**	**-1.8%**
Willows Road			4,869			797		
	5.1	Vanpool Program		-19	-0.4%		-1	-0.2%
	5.2	Alternative Mode Subsidy		-27	-0.6%		-2	-0.2%
	5.3	Telecommuting		-8	-0.2%		-1	-0.1%
	5.4	Increased Density Near Transit Corridors		16	0.3%		1	0.1%
	5.5	Bicycle Access		-29	-0.6%		-5	-0.7%
		Combined:		**-69**	**-1.4%**		**-8**	**-1.0%**

TABLE 3-5 (Continued) – Results of TEEM Applications: Change in PM Peak Period Commute Trips

		From the Study Area			To the Study Area		
		Base	Change	Percent Change	Base	Change	Percent Change
Downtown Kirkland		1,906			1,272		
6.1	Telecommuting		-3	-0.2%		0	0.0%
6.2	Multi-Employer TMA		-26	-1.4%		-2	-0.1%
6.3	Restricted Parking Supply		0	0.0%		0	0.0%
6.4	Parking Pricing at Employment Sites		-180	-9.4%		-11	-0.9%
6.5	Flexpass/Residential Pass		-2	-0.1%		0	0.0%
	Combined:		**-207**	**-10.9%**		**-13**	**-1.0%**
Totem Lake		7,379			1,906		
7.1	Vanpool Program		-20	-0.3%		-1	-0.1%
7.2	CTR-type Program for Small Employers		-71	-1.0%		-4	-0.2%
7.3	Multi-Employer TMA		-90	-1.2%		-6	-0.3%
7.4	Parking Pricing at Employment Sites		-390	-5.3%		-24	-1.3%
7.5	Flexpass/Residential Pass		-7	-0.1%		0	0.0%
	Combined:		**-572**	**-7.8%**		**-36**	**-1.9%**
Downtown Bellevue		23,230			7,488		
8.1	Alternative Mode Subsidy		-220	-0.9%		-14	-0.2%
8.2	Increased Density Near Transit Corridors		-7	0.0%		0	0.0%
8.3	Encourage Mixed-Use Development		-284	-1.2%		-18	-0.2%
8.4	Encourage Infill & Densification		0	0.0%		0	0.0%
8.5	Parking Pricing at Employment Sites		-371	-1.6%		-23	-0.3%
	Combined:		**-736**	**-3.2%**		**-46**	**-0.6%**
Crossroads		2,323			1,973		
9.1	Alternative Mode Subsidy		-13	-0.6%		-1	0.0%
9.2	Increased Density Near Transit Corridors		-3	-0.1%		0	0.0%
9.3	Encourage Mixed-Use Development		-9	-0.4%		-1	0.0%
9.4	Encourage Infill & Densification		-16	-0.7%		-1	-0.1%
9.5	Flexpass/Residential Pass		-1	0.0%		-14	-0.7%
	Combined:		**-21**	**-0.9%**		**-16**	**-0.8%**
Redmond Ridge		1,705			4,329		
10.1	Vanpool Program		-28	-1.6%		-2	0.0%
10.2	Alternative Mode Subsidy		-17	-1.0%		-1	0.0%
10.3	Compressed Work Week		-30	-1.7%		-2	0.0%
10.4	Bicycle Access		-20	-1.2%		-57	-1.3%
10.5	Flexpass/Residential Pass		-1	-0.1%		-15	-0.3%
	Combined:		**-96**	**-5.6%**		**-76**	**-1.8%**
Total All Case Study Areas		**61,420**	**-2,732**	**-4.4%**	**23,190**	**-357**	**-1.5%**

FIGURE 3-1 – Predicted Average Change of Tested Strategies over all Case Study Areas

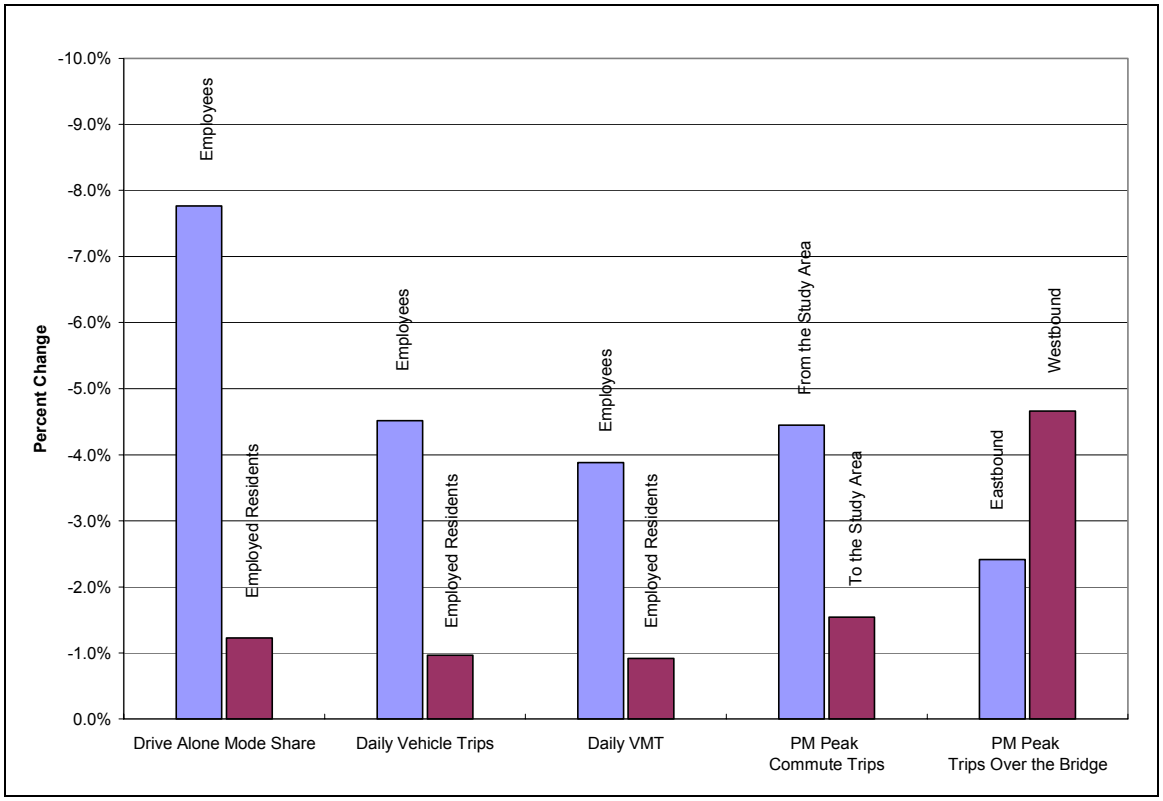
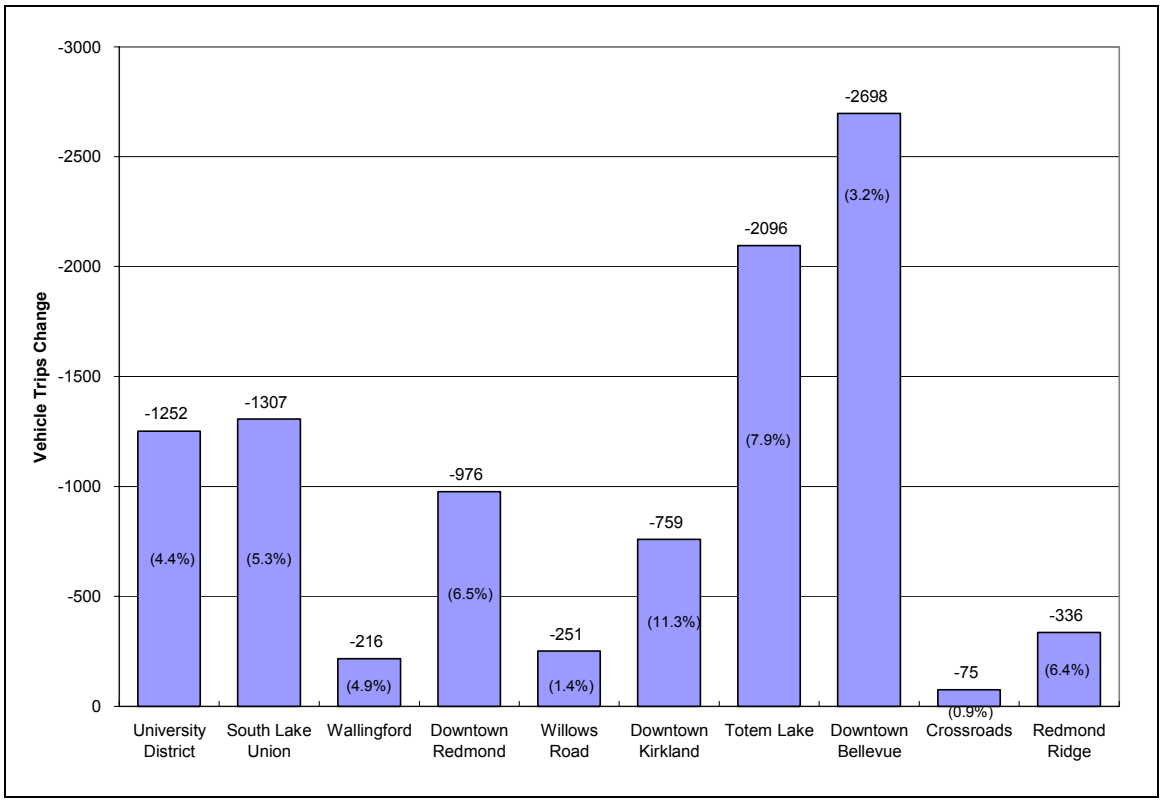


FIGURE 3-2 – Predicted Reductions in Daily Commute Vehicle Trips by Study Area Employees



3.3. Recommendations

3.3.1. Components of an Effective Corridor TDM Strategy

The *Modeling TDM Effectiveness* project represents a unique effort to systematically quantify the roles that demand management and land use strategies can play in the long-range maintenance of mobility in a major urban corridor. The project is also unique in producing software (TEEM) for demand management analysis that estimates the impact of TDM strategies, not only within the subarea where the strategies are to be applied, but also within a specific corridor being analyzed. The results from the testing of strategies in the ten case study areas suggest that the most effective approach will be a combination of strategies that provide:

- Pricing
- Transit & Non-motorized Supportive Land Use
- Promotion/Coordination
- Alternative Mode Options

Characteristics of TEEM

Forecast year is 2030

Focuses on commute trips

Works at the neighborhood/subarea level

Estimates incremental change in travel characteristics

Based on historical rates of effectiveness

Majority of data from King County

Such a combination of strategies would work together supportively and could be tested in all of the case study areas.

A package of improvements that includes a combination of pricing (parking pricing and alternative mode subsidy), land use strategies, supply of alternative modes, and promotion/coordination should be tested in all of the case study areas. Such a package of strategies would be consistent with the TDM recommendations that were made as part of the SR 520 EIS. Those recommendations included the following elements:

- Oversight Program – a program of adaptive management to administer, monitor, evaluate and adjust implementation of the TDM strategies over the 20-year program period
- Public Information and Education – A program that includes a corridor-focused information and education campaign that targets commute trips but also provides outreach for non-commute markets as well.
- Vanpool Programs – a program that provides extensive new marketing of public vanpool programs, assistance in acquiring new vanpool vehicles, rideshare parking programs to supplement permanent park-and-ride lots, and vanpool fare subsidies.

- Employer-Based Programs - programs to increase the use of work schedule options; additional incentives and resources for Commute Trip Reduction (CTR) and non-CTR affected employers; support for Transportation Management Associations (TMAs); and promotion of parking cashout programs.
- Land Use as TDM - a program that would provide support programs for local jurisdictions and developers; incentives for jurisdictions, developers and businesses; and funding for local connectivity projects.
- Other TDM Programs – an additional element that includes innovative fare media, non-commute trip programs, incentives for freight and commercial vehicles, custom bus services and funding for demonstration programs.

Additional support for alternative mode use will be provided by a substantial increase in transit service in the corridor as part of the SR 520 EIS's main recommendations. Use of pricing on the along the corridor is also being considered both as a method for paying for corridor improvements and as a disincentive for driving alone.

3.3.2. Additional Analysis in SR 520 Corridor

To complete the analysis for the SR 520 corridor, there should be testing of additional strategies in the original ten case study areas to determine the optimal set of strategies for implementation. This should include testing of "Parking Pricing at Employment Sites" in all of the case study areas. The initial tests of strategies limited the test to only five strategies in each area, but a complete package of strategies may require more strategies for some areas. Because of the ease with which strategies can be tested for a case study area, consideration should be given to testing all of the strategies in all of the ten case study areas.

TEEM can also be used to test the potential effectiveness of TDM and land use strategies in other employment centers in the corridor. The results from the areas already analyzed can provide guidance for what might be most appropriate to test in other areas. Below is a list of recommendations for additional activity centers in or near the SR 520 corridor, based on the study areas already evaluated:

Seattle

Northgate - The Northgate area is a strong mixed-use community with similar characteristics to Totem Lake (although with stronger transit focus) and the University District. The Crossroads area also may have applicability on the employer strategies.

Downtown - Downtown Seattle is the region's largest market for TDM strategies, primarily with a transit focus. It would be useful to compare the effectiveness of the various strategies tested in Downtown Bellevue and other areas to findings that would be expected in Downtown Seattle. Downtown Seattle was not included in the first set of case study areas because there was a general feeling that the area may already be "tapped out," but the initial testing of case study areas indicates large potential gains in areas that already have TDM programs in place.

First Hill – First Hill is a high-density, mixed-use area adjacent to downtown Seattle with a concentration of large hospitals. Strategies that were effective in South Lake Union, the U-District or Downtown Bellevue may be applicable for First Hill.

Kirkland

Juanita - The new Juanita Village is a mixed-use development that offers potential for improved mobility due to land use density and connectivity. Established single and multi-family residential zones dominate the rest of the area. Findings from Wallingford for *Improved Bicycle Access* and *Flexpass/Residential Pass* might be applicable.

Carillon Point - This center contains a mixed use of office and retail with multifamily housing in close proximity. The area's relatively small size limits some TDM strategies, although selected employer strategies studied in Downtown Kirkland, Redmond, and South Lake Union offer potential applications.

Bellevue

Factoria - The Factoria area has many similar characteristics to Totem Lake and Crossroads. The mixed office/retail environment plus an expanding multifamily residential and mixed-use development market could be tested against a variety of TDM strategies.

Bel-Red/Northup - this area has most retail land uses but dispersed and low-density office. Some findings from Willows Road and Crossroads may be applicable.

Eastgate - Eastgate has an abundance of medium-density office and scattered auto-oriented retail development. Residential options are primarily in single-family neighborhoods on the periphery of this area. Case study findings from Totem Lake, South Lake Union and Willows Road may be applicable.

Lakemont - The Lakemont community is largely a mix of single and multi family development with a community retail center. Findings from Redmond Ridge may have applicability.

Redmond

Southeast Redmond - Southeast Redmond is similar to Willows Road in the clustering of suburban employment centers and warehousing. Findings from employment sites in Totem Lake may also have applicability.

Northeast Redmond - Northeast Redmond is largely a single-family neighborhood with limited mixed-use development or other uses. Some of the residential-based programs tested in Redmond Ridge and Wallingford may be applicable. The transit system in Northeast Redmond is much less developed than Wallingford, so much so such that results from that area should be further examined.

Grasslawn - Grasslawn contains a mix of suburban employment (mostly high tech) surrounded by an established single-family residential development. The employment areas have characteristics similar to Willows Road, Totem Lake, and South Lake Union.

Residential strategies, such as those used in Wallingford, may be applicable in this area given reasonably good transit service.

Overlake – Overlake is a large medium-density suburban employment center located on the edge of Redmond and Bellevue. It was not included in the original set of case study areas because it had been the subject of a fairly aggressive TDM program developed by Redmond and Bellevue. Strategies effective in Downtown Bellevue and Totem Lake may be most applicable for Overlake.

As more resources become available to expand and improve TEEM, several key areas are recommended for refinement. Consideration might be given to revising the application of land use strategies in TEEM that would allow shifting of future growth from one case study to another. Two of the three land use strategies proved to be effective when implemented within the study areas. It is possible that there could be even greater effectiveness if the strategy can be implemented across study areas. New research is already underway to enhance TEEM's analysis of land use strategy effectiveness. As that research is completed and integrated into TEEM, revising TEEM to allow reallocation of growth across study areas would further improve its ability to model impacts of land use changes on travel behavior.

3.3.3. Enhancement of TEEM

It is also recommended that new applications for TEEM in other corridor studies be sought. An immediate opportunity for application is in the I-405 Corridor Program. As new applications arise TEEM could be refined through additional research on TDM and land use strategy effectiveness. To facilitate new applications, consideration could be given to how to link TEEM directly to the PSRC's regional travel model (or other model used for corridor analysis), in order to automate the process of setting up TEEM for case study area analysis. Much of the data for the case study areas came directly from a regional model, so automating the connection may save substantial time for future applications.

Information on TDM experience generated by the State's Commute Trip Reduction (CTR) program was crucial to this project. Ten years of reporting on the strategies implemented and their effects on commute mode shares have been evaluated comprehensively. More work with the CTR database would yield new information about the effectiveness of employer-based TDM programs. This could include the collection of more accurate information on employer costs of implementing the programs and types and amounts of subsidies offered by employers as incentives. Enhancement of the CTR database could also include the development of a physical description of area characteristics and transportation facilities near each employment site. This additional information could provide useful information to explain differences in program effectiveness between employers.

3.4. Recommended Next Steps

The next steps in the evaluation of TDM and land use strategies in the SR 520 corridor should be as follows:

1. Test additional strategies in the ten case study areas to determine the optimal level of TDM and land use strategy implementation in the ten case study areas.
2. Test TDM and land use strategies in additional study areas in the SR 520 corridor to determine the maximum potential for TDM and land use effectiveness in the corridor.
3. Expand TEEM to work in other corridors and with other TDM/land use strategies, and refine the tool so that it is better able to estimate the effectiveness of existing strategies.
4. Establish TDM goals for the SR 520 corridor.
5. Refine strategies to help meet TDM goals for the case study areas and the SR 520 corridor.

Recommendations Summary

Components of an Effective Corridor TDM Strategy
- *Pricing*
- *Transit & Non-motorized Supportive Land Use*
- *Promotion/Coordination*
- *Alternative Mode Options*

Additional Analysis in SR 520 Corridor
- *Test additional strategies in study areas*
- *Test other employment centers in corridor*

Enhance TEEM
- *Revise analysis method to allow testing of land use strategies on a corridor-wide basis*
- *Automate data transfer process from models*
- *Add more strategies, including non-commute strategies*
- *Expand effectiveness factors to include market potential*
- *Further verify CTR data and add data for other counties in the region*
- *Expand capability of TEEM to estimate a full corridor program at a corridor level*

Establish a TDM Effectiveness Monitoring System for the Region